INTERNATIONAL

PROJECTIONIST

JANUARY 1939

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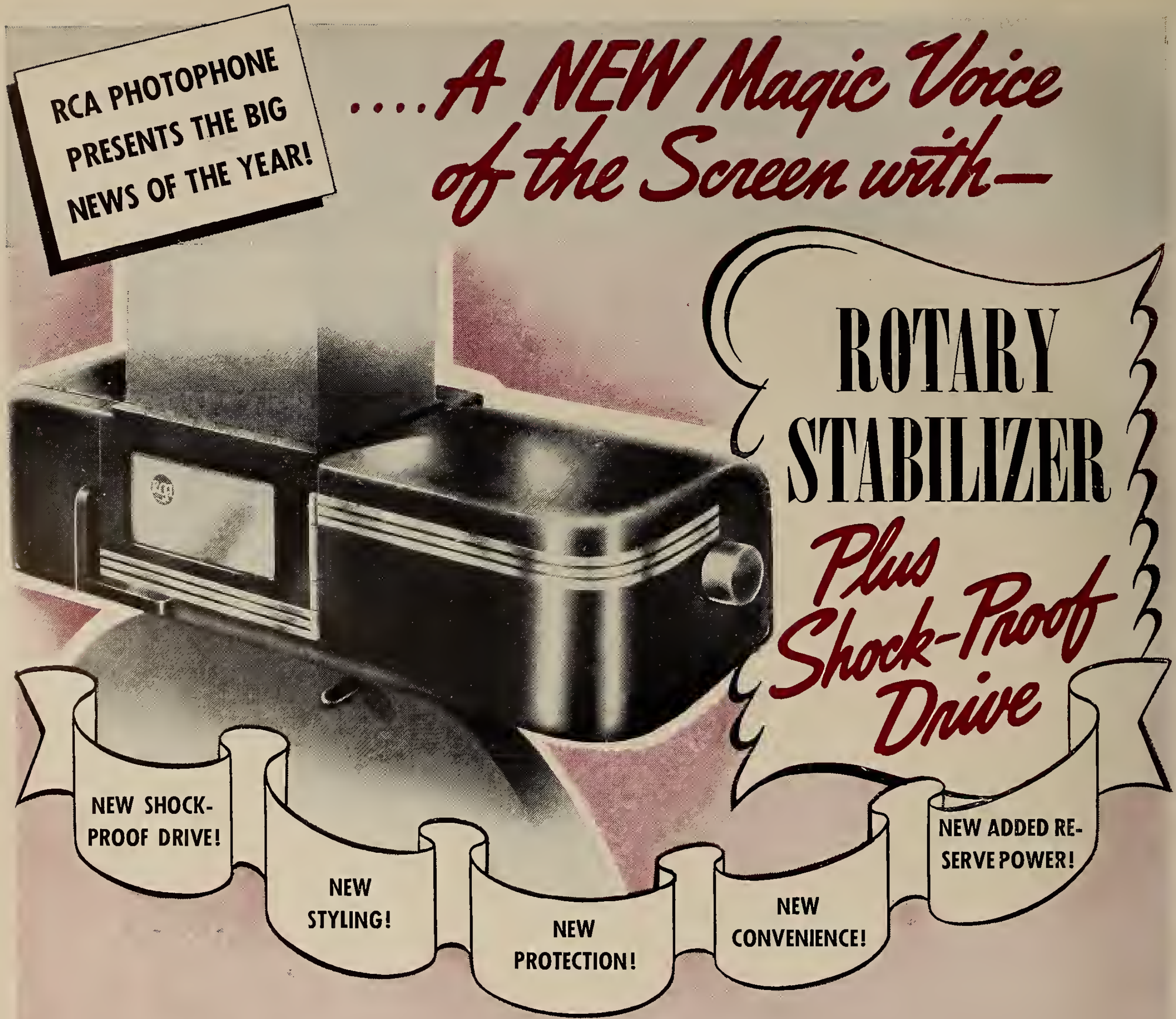

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International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

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Monthly Chat

ROAMING through the far reaches of upper N. Y. State, Canada and the Middle West during the past month we visited with and addressed 16 I. A. Local Unions. The chief topic? Television, of course. Too much about the technical aspects of this art neither we nor our hosts knew or know, but we were surprised at the pessimism evidenced anent the effect of television upon the future of the motion picture theatre.

Nobody with whom we spoke doubted that theatres would be slaughtered by the advent of television; the question unvaryingly posed was "How soon?" Fortunately or otherwise, depending upon one's viewpoint, we had prepared a little talk on this very topic; and strangely enough, after we had given this speil the boys felt a little better. This parcel of gab, together with other assorted data anent television, is published elsewhere herein. See how you feel after digesting it—not forgetting, of course, that the opinions of I. P.'s editor are those of one who is also trying to find his way out of the darkness into the light.

• • •

We have always held that 99% of I. P. readers cared little about studio projection procedure. Publication of Merle Chamberlin's article last month gave us a severe shock and forced us to admit we were wrong—to just about the extent of the aforementioned percentage. This being so, we have planned another little foray into the studios, the results of which will be available shortly. Don't run, Merle.

• • •

INCIDENTALLY, the craft is running a fever induced by that decision of the Oklahoma State Supreme Court (I. P. last month) upsetting a compensation award to a projectionist badly burned in a theatre fire and classifying projection work as a "non-hazardous" occupation. Mr. Chamberlin suggests that I. P. "take up the cudgels" in behalf of the craft in this situation. Our opinion that this is properly a job for the state or district legislative bodies doesn't mean that we shan't see what can be done about this. Where, oh where are those projectionist technical organizations (A.P.S. and P.A.C.) now?

• • •

On a recent Sunday night within a four-hour period there were *only* 24 ranking Hollywood film players on the three major radio networks. Without picture contracts these "players" (and are some of them terrible!) couldn't even get into a broadcasting studio. Not forgetting the studio audiences at these gay little parties—while theatre cashier's hands are freezing through inactivity.

INTERNATIONAL PROJECTIONIST

VOLUME XIV NUMBER 1

JANUARY 1939

Matching Various Units of Theatre Public Address Equipments

By *AARON NADELL*

MATCHING equipment components for theatre p.a. work presents theoretically the same problems encountered in sound picture systems, but in practice the projectionist is often confronted with special difficulties. Sound picture equipments are usually delivered to the theatre as engineered units, the components of which have been properly matched in factory design. They serve the single purpose of film reproduction.

Public address apparatus, to the contrary, usually is required to perform a variety of services, from reinforcements to ballyhoo. Except in the largest theatres, it is likely to be not an engineered unit but a patchwork; managers tend to call for additional microphones, speakers, *etc.*, as needs for enlarged facilities arise, and the man in charge is responsible for matching the new parts to the old ones. If the p.a. system has been built up around the sound picture amplifier, as it often is, the reinforcement parts must match not only each other but the synchronous equipment as well.

Furthermore, p.a. work involves a special requirement in the way of securing satisfactory match, which may be referred to conveniently as coordination of frequency response. Suppose that a loud speaker, for example, is 3 db more efficient at 1,000 cycles than at any other level. Such a condition is common, and when not carried to extremes, is unimportant practically.

● Frequency Coordination

Now, if the amplifier also has a 3 db peak at 1,000, the system as a whole presents a 6 db peak at that frequency. If several different components all peak at the same tone, it is obvious that the system as a whole will produce distorted sound. Consequently, interacting components that do not have a truly flat response (few have) should at least be so coordinated that they will not reinforce each other's defects. With a speaker of the kind indicated, the amplifier should peak, if at all, at some frequency other than 1,000 and other than a harmonic of 1,000.

Now, in talking picture systems, imperfect frequency coordination does no harm other than to impair the sound quality. With microphone equipment the results may be far more serious, for if the system is peaked to the extent of introducing acoustic feedback, it will not work at all. Nothing will be heard but a squeal or howl at the pitch of the frequency in question.

This point was touched upon in I. P. recently[1], but its relation to proper matching of apparatus was not stressed at that time. Briefly, loud speaker sound re-entering the microphone where it originated is again amplified, again leaves the loud speaker and returns to the microphone to undergo further amplification, and so on. The unavoidable requirement of microphone operation is this: the loss in volume between loud speaker and microphone must be *greater* than the gain of amplification between microphone and loud speaker.

When the desired condition exits, it

[1]Dec., 1938, p. 3.

is obvious that each time the sound goes round the circle it gets back to the microphone weaker than it was the last time, so it soon dies out. When, however, the amplification is greater than the loss in air between loud speaker and mike, it is plain that every time the sound gets back to the microphone it will be stronger than previously, and instead of dying out it will increase in strength up to the power limits of the system.

It is plain, further, that the tone or frequency at which the system is most efficient will be the one most quickly built up to the limit of system power. Hence that one frequency, under those circumstances, will be the only one heard.

To avoid this condition it is necessary to either cut down amplification or increase the air loss between loud speakers and microphones, or both. Both means are employed. But if the system is exceptionally efficient (highly peaked) at some one frequency, feedback may occur at that frequency long before the volume control has been brought up high enough to make the sound as a whole usable. Under those circumstances satisfactory operation is impossible. Equipment components of a flatter characteristic response must be substituted. That means more expensive components.

Coordinating components which are somewhat peaked, so that they don't all peak at the same tone, is one way of reaching an acceptable compromise. When the system as a whole is sufficiently flat, proper speaker placement and baffling, proper choice and placement of microphones, or use of directional microphones, or all three, will allow volume to be brought up to the point of satisfactory operation without so strongly accentuating any one tone as to allow feedback to set in.

As a practical problem in p.a. work, this matter is almost entirely one of choosing suitable microphones and speakers. It is comparatively easy and inexpensive to build an amplifier of a satisfactorily flat response, and amplifiers built nowadays have few if any significant peaks in their action. Truly accurate curves of microphone and speakers can be obtained from all the better makers; but if there is any question of the curve having been drawn with sufficient detail, the manufacturer may be queried as to the frequencies at which any significant peaks appear. All the more reputable makers will answer accurately.

Aside from frequency coordination, p.a. apparatus presents distinctly important problems of impedance match and power match. It is customary to figure these problems by beginning with loud speakers—which represent the performance requirements—and working backward. But in theatre installations it is often desired to make use of the sound picture amplifier and build p.a. equipment around that. In such cases one can only begin with the amplifier and work outward in both directions. Speaker arrangements should be investigated first, however, because if the amplifier cannot possibly meet the speaker requirements (that is, give the necessary performance) it is useless to consider it further; another amplifier will have to be obtained for p.a. purposes.

● Speaker Power Requisites

It is important to note at once that the ability of an amplifier to provide sufficient sound for talkie purposes does not mean that the same amplifier can provide adequate p.a. volume. That would follow only if the p.a. speakers were fully as efficient as the sound picture speakers. But it so happens that the better sound picture systems use speaker units that range up to thirty percent efficiency or better, whereas the more common radio or p.a. speakers can often convert into sound energy only five or ten percent of the power they receive as electrical energy, wasting the rest as heat.

It is clear that the same amplifier may be unable to fill a theatre with sound when called on to work through speakers of materially lower efficiency. The first problem with reference to using a talkie amplifier for p.a. work is, therefore, consideration of speaker efficiency differences in relation to the amplifier's reserve power capacity. This means in practice than an amplifier customarily operated at or near peak volume for talking picture work will be of dubious utility for p.a. sound.

But a gain of 3 db is equivalent to doubling volume; if the amplifier gain is raised 6 db, its output is increased four times; a 9 db increase (three steps on some types of volume control) is a power gain of 2 x 2 x 2, or 8 times. Such a gain will easily be enough to compensate for any reasonable differences in speaker efficiency. It may not be enough, however, to compensate for the use of additional speakers, as sometimes required for the lobby or for ballyhoo outside the box office.

These considerations apply with equal force whenever additional speakers are for any reason to be wired to existing p.a. equipment. They also involve a special difficulty in that comparatively few manufacturers either do or can give accurate information anent the efficiency of their speaker units. Consequently if the picture sound system uses loud speakers especially designed for that form of service, it will generally be advisable to figure on *at least* a 9 db increase in amplifier output for p.a. speaker units of fairly good quality. If the picture system makes exclusive use of speakers of the p.a. type (as some do) allowances are clearly unnecessary. This latter condition will be the exception rather than the rule.

● Speaker Power Distribution

Some sound picture systems, especially in small houses, use only a single loud speaker (centrally located behind the screen), but two speakers at least represent the minimum for ordinary reinforcement work. To conceal the source of artificial sound from the audience it is sometimes necessary to use many more than two. The total power output may be divided among the speakers equally or unequally according to the requirements imposed by the individual auditorium in the matter of good acoustic results, and good illusion.

A possible source of confusion should be avoided at this point by noting that distribution of volume among speakers to obtain good acoustic results and good illusion has nothing in common with the distribution of power between high-frequency and low-frequency units in modern sound picture systems. The p.a. system that uses separate h.-f. and l.-f. speakers is so rare as to be almost non-existent in modern theatre work. The vast majority use a single set of speakers for all frequencies, consequently the problem of distributing volume among them has nothing to do with frequency filter networks; it is a relatively simple matter of respective impedances.

If all speaker units are connected across the same set of amplifier output terminals, and if all are of the same impedance, then necessarily all will receive the same proportion of the total power.

If the speaker line impedances are

Getting the 'Bird'

Credit Charley Dentlebeck, supervisor of projection for Famous Players Canadian Corp., for passing along this all-time, all-champ projection room report:

"Four interruptions within an hour due to a bird getting into the ventilating system and working its way through the lamphouse into the back shutter of No. 1 projector, causing stoppage. Film was transferred to No. 2 projector; five-minute delay. Three other delays of one minute each for re-threading No. 2 projector while trouble was being cleared on No. 1. Following gears replaced: G-112-G, P-220729, and G-134-G."

We know they grow them big in Canada (the birds, we mean) but stripping gears in this manner would require at least an eagle. Incidentally, title of picture was "Goldwyn Follies".

not all the same, then the current will divide among them inversely to impedance, the speaker line having the highest impedance receiving the least power, and *vice versa.*

A simple way of obtaining unequal line impedances for the purpose of causing power to divide unequally is to equip certain speaker lines with individual volume controls. In the interest of economy, controls are not associated with those speakers that are to work loudest. Sound is set to suit these at the amplifier volume control, and the individual controls associated with the other units (or groups of units) are then adjusted accordingly.

Simple potentiometers can be used for such controls, at a cost probably of less than one dollar each (depending upon the power requirements), but this is not the best practice. Pads of some type, ladder pads for example, can be adjusted to vary the speaker volume without changing the pre-determined line impedance. (A related but less effective form of volume control, the T-pad circuit, is traced in I. P. for July, 1935, pp. 10-11.)

The use of pads for individual speaker controls is open to the practical objection that they are somewhat expensive, particularly when the power involved exceeds two or three watts. Further, there is no real need for pads where individual speaker volume is not to be varied from time to time but will be permanently fixed with reference to the volume from all other speakers.

The simplest and most effective of all methods of securing any desired degree of unequal distribution of volume is to choose the individual speaker impedances suitably. This method can best be described after normal methods of matching impedances have been considered.

● Speaker Impedance Match

Accepting as accurate manufacturers' ratings of the impedances of parts and circuits, the simple arithmetic for impedance calculations in the theatre is exactly the same as that for figuring d.c. resistance (discussed in quite some detail in I. P. for Nov., 1938, pp. 7-9). In ordinary p.a. work as encountered in the theatre amplifier output transformer secondaries, speaker input transformer primaries and speaker voice coils are treated exactly as if those parts were straight resistances working on d.c. The only difference is that the ohmmeter cannot be used to check the manufacturers' ratings, or to substitute for them.

Consequently, if an amplifier is built with a 500-ohm output, and four speakers are to be used, each having 2,000 ohm transformer primaries, the four need only be connected in parallel to provide a perfect match. Similarly, four 125-ohm speakers (or their transformers) could be wired in series to match. In either case, volume would be divided equally among all speakers.

Where unequal volume is wanted, assume for example that two of the speakers are to be given only one quarter as much power as their partners: a simple solution might be to connect the 500-ohm inputs of the two low-volume speakers in series, making a 1,000-ohm circuit. Connect the 500-ohm inputs of the two high-volume speakers in parallel to create a 250-ohm circuit. Division of power between these two circuits will then be in the ratio of 4 to 1, and both can be connected to a 200-ohm amplifier output for a perfect match; or if the amplifier is not so equipped, the 250-ohm output terminals, which are more common, will give a mismatch of only 20 percent, which is tolerable.

In more complicated cases very interesting gradations of power can be effected, even among a relatively large number of speakers, by following the

Compensation Laws Sizzle Craft

By **MERLE CHAMBERLIN**

CHIEF PROJECTIONIST, METRO-GOLDWYN-MAYER STUDIOS

THE action of the Oklahoma State Supreme Court in setting aside a compensation award to one Albert G. Johnson for burns suffered during a projection room fire (I. P. for Dec., p. 24) occasioned considerable comment among West Coast projectionists, and, I am sure, among members of the craft throughout the country. Classification of projection work as "non-hazardous employment" because it does not constitute a "workshop" under Oklahoma law is sharply inconsistent with the generally adopted view elsewhere anent the many occupational hazards incident to motion picture projection work.

Being keenly interested in this matter, I endeavored to ascertain through the M-G-M Studio compensation representative the significance of this Oklahoma decision. The appended reply from the insurance brokers, while concerned primarily with the California compensation law, contains sufficient information of general interest to warrant attention by projectionists throughout the country: The letter, in part, follows:

"You have asked us to give an opinion . . . whether in the light of this decision a projectionist working in California would be covered under the compensation laws.

"The point involved in the Oklahoma case . . . would not arise under the California law. The Oklahoma Act applies to 'manual or mechanical labor of a hazardous nature . . .' Apparently, from the recitation of facts when this particular case was submitted to the Industrial Commission of Oklahoma, they decided that the occupation was 'of a hazardous nature' within the meaning of the Act. The case was appealed, and the State Supreme Court set aside the award of the lower court and held that the State law did not classify occupation in the theatre industry as hazardous employment within the meaning of the Act.

● State Compensation Laws Vary Widely

"The California Act differs materially in that it does not restrict application of its laws to certain forms of employment. Under the heading of 'Employment Covered' the California Act covers 'all public and private employments.' There are certain minor exceptions that have no bearing on this case.

"A considerable number of state compensation laws contain provisions similar in form to the Oklahoma Act in that they are intended to apply only to so-called 'hazardous employment.' The status of projectionists has been doubtful under many of the acts and is generally considered borderline. In some states, notably Washington and Oregon, where the acts apply only to hazardous employments, it has been held specifically that projectionists come within this class.

"We handle the insurance for several theatre chains extending into these states, and have found it necessary to purchase special State Fund Insurance on projectionists employed in these theatres. The Compensation Act does not apply to any other theatre employees, who are treated separately from the insurance standpoint."

The foregoing letter says it all—or at least enough to warrant the statement that I. P. would be doing a wonderful service to the craft if it would take up the cudgel and clarify the status of projectionists under the compensation laws of the questionable states, of which I understand there are several.

same general method. Loud speakers of the public-address type are commonly obtainable equipped with input transformers having a large number of taps to their primary windings, giving a very free choice of available input impedances; and p.a. amplifiers, unlike sound picture amplifiers, are usually built with output transformers offering an option among as many as perhaps twenty different output impedances.

Further choice still can be had by eliminating the speaker input transformers and wiring to the voice coils direct. With these facilities available, a little patience and trial-and-error (on paper, not in actual wiring) will make possible almost any desired loud speaker arrangement, to suit all theatre problems. Very complicated requirements may even call for several hours with pencil and paper involving nothing more difficult than the arithmetic of fractions.

The real difficulty of the work lies in determining in advance just what percentage of the total volume output each individual speaker should have. That may call for some trial-and-error work in actual wiring, changing speaker transformer tap connections until a number of actual trials have given fair insight into the real requirements. All such tests should also be calculated in advance to make certain what is the exact distribution in each case.

This method is particularly suitable where additional speakers are to be added, either in an auditorium, in a lobby or outdoors. Granting only that the amplifier has enough reserve power to accommodate the addition, proper impedance match can readily be preserved when wiring-in new speakers, and correct allocation of volume to the newcomers arranged at the same time.

● Multiple-Service Units

In some theatres some or all of the p.a. apparatus is used for more than one function. Certain components may even be portable or semi-portable in nature. The simplest example is when a microphone, normally used on the stage, is unplugged for temporary use on a sound truck. However, the amplifier itself may be transferred to a truck on occasions when it is not needed inside the theatre. A variation is to take a sound truck amplifier into the theatre, along with a storage battery to provide power for its operation and a charger to keep the battery in condition. Some special p.a. amplifiers can be made to work either from a 6-volt storage battery or from a 110-volt a.c. line, merely by plugging in different power connections. They are not particularly expensive.

One item of equipment, however, is seldom transferred outside the auditorium. Speakers and baffles best suited to indoor work are not always adaptable to outside operation. In addition, really satisfactory speaker placement and adjustment for best auditorium results is usually too difficult to obtain to justify upsetting it for any trivial reason. Buying a separate set of speakers for outside work is likely to prove more economical in the end. For all these reasons the auditorium speaker setup is seldom disturbed.

However, some one speaker, so located as not to need too critical pointing, may occasionally be removed to serve temporarily outside the box office, or to lend sound effects to some ballyhoo cutout or attraction sheet. A number of interesting tricks have been used for front-of-the-house appeal, including the old one of the cutout wizard, wired with a microphone and speaker, who answers the questions of passersby.

A variation in the way of flexibility which does not involve the physical removal of any apparatus, hence is preferable, is based on the method of wiring in supplementary speakers — at the marquee, in the lobby, in the lounges or elsewhere—but playing them only at selected times.

Maintaining impedance match regardless of the switching of such speakers is simply a matter of using a d.p.d.t. switch and a dummy load resistor. The dummy resistance in ohms will equal the speaker input impedance in ohms, and both will have the same power rating. The total line impedance is then calculated exactly as if the speaker in question were always in use, which in effect it is—when it is not playing the dummy load effectively takes its place for all electrical purposes. Similarly, if an auditorium speaker is temporarily removed, whether for use on another circuit or only for repairs, a suitable resistor should be connected in its place.

● Speaker Field Matching

Matching speaker fields is a matter of maintaining correct resistance and wattage values. Until recently it was a subject just as important and difficult as maintaining impedance match, and handled in much the same way. The advent of effective, high-power permanent magnet speakers has greatly minimized this problem.

Whenever additional speakers are to be installed, the permanent magnet kind can be used, eliminating all excitation problems and saving enough in wiring costs to more than make up the small difference in price. However, many p.a. amplifiers still are built with speaker field exciting circuits incorporated in their power arrangements. Where these exist, the power they provide must be dissipated in some ay. A bleeder resistor may be connected across the field power output terminals, or all or some of the speakers used may be of the electro-dynamic type to take advantage of the power available. Generally, however, permanent magnet units are preferable as being slightly less likely to break down, less complicated to investigate in emergencies, less expensive to wire and incapable of producing hum on their own account.

Matching of microphones and other input sources will be discussed in a subsequent issue.

Letters to the Editor

To the Editor of I. P.

As you know, I read every word of your excellent publication (which is just too bad for you sometimes, this being one of them) and almost always I find myself in agreement with you. In your Monthly Chat for the Dec. issue, however, you state: "The year 1938 can be marked down as one of the dullest ever from the standpoint of progress in projection equipment and technique."

Now, I believe it to be time that you read your own publication as diligently as do your readers, particularly myself. In your issues for April and May, 1938, you commented at length about the wonderful strides forward represented by the new Simplex E-7 projector and the Simplex 4-Star Sound System. "Will you love me in December as you did in May?"

If your statement in this instance be correct, then it cost this company about $300,000 to prove you right and ourselves wrong. However, reports from the several hundred theatres which have installed the aforementioned equipment (I shan't mention the name Simplex) indicate that we did a pretty good job on this equipment.

Well? . . . I don't like the taste of crow myself.

HERBERT GRIFFIN
International Projector Corporation

[*ED.'S NOTE: A swell job by International Projector being one of those things that is taken for granted by the industry throughout the world, the super-excellence of the "aforementioned" equipment (I shan't mention the name Simplex) needed no special reference. The foregoing is probably the first wholly truthful alibi on record.*]

To the Editor of I. P.

In my article anent Studio Projection in I. P. for Dec.: on page 16, second column, second paragraph appears the statement, " . . . or without inducing poor definition as a result of an abnormally small stop in the lens." This statement was originally written as, " . . . or without giving our people (the studio) false definition, which an

abnormally small stop in the lens would do."

The substitution of the word "poor" for the word "false" might be confusing to some readers. I elected to use the word "false" because an abnormally small stop will give abnormally sharp definition, which is impossible to obtain in a majority of theatres. Naturally, my policy is to give our executives projection approximating that obtainable in theatres, thus I avoid the false definition which would result from a small stop, which I could very easily use with the great quantity of light available.

MERLE CHAMBERLIN
Supervisor of Projection
Metro-Goldwyn-Mayer Studios

Fourth Subscription Contest Diagram; Few Winners on a Simple Circuit

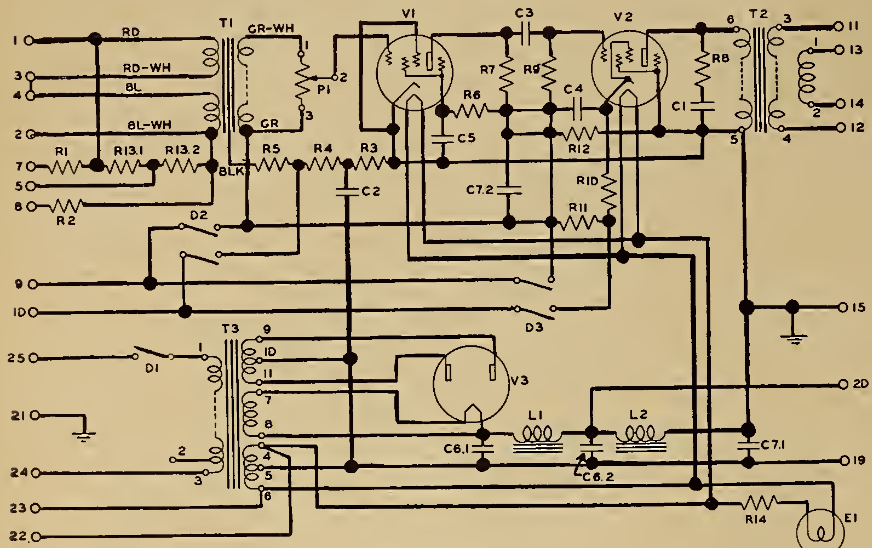


FIGURE 1

THE switch from the better known types of sound picture circuits to those intended for other purposes apparently has toughened up the Diagram Contest considerably. Yet there is no reason why one who is assumed to know his circuits should be either stuck by or object to the switch in type of circuit.

This month's Contest entry (Fig. 1) is of a type that affords an equal chance for all, the possibility of anybody being overly familiar with it either through use or by consulting a reference work being remote. Which is exactly as it should be. Most of the circuit has been redrawn, thus rendering futile any detective work through faulty draftsmanship. The several errors contained therein refer *not at all* to circuit constants, being related exclusively to connections. What's difficult about that?

As is customary, only subscribers to I. P. are eligible to compete in this Contest. All answers must reach I. P. not later than Feb. 20. The award will be the same—one year's free subscription to I. P. for every successful contestant. It is not necessary to enclose a copy of the Contest diagram, although this is elective on the part of contestants.

Last month the boys again did not do so well. Incidentally, the circuit was that of the W.E. 108-A voice amplifier used for broadcast work (Fig. 2). There were only eight winners out of more than 100 contestants. Here is the listing of the errors therein:

1. Jumper added between input terminal 21 and input terminal 22.
2. Jumper added between output terminal 15 and filament of E-3.
3. Connection (dot) removed from first crossing below left-hand side of R-9.
4. Connection (dot) removed from crossing, top terminal of R-7.
5. Connection (dot) inserted at crossing between terminal 7 of T-3 secondary and filament of V-4.
6. Condenser C-7 short-circuited across its plates.

Reversing these changes in the diagram will give the correct circuit. Some contestants seemed puzzled by meter M-1, which connects across the output line externally to this diagram. Others thought M-2 incorrectly wired as an ammeter, whereas in fact R-3, R-9 and R-15 serve as shunts for it in a standard ammeter hookup. Others failed to see that R-10 and C-6 constitute a reverse-feedback circuit. One contestant was unfamiliar with the *internal* suppressor grid-cathode connection in V-3.

The eight contestants who scored on last month's entry are as follows: Francis L. Hill, St. Petersburg, Fla.; Russell A. Schrempp, St. Louis, Mo.; George Wilde, Columbia, Ill.; C. H. Perry, Sudbury, Ont., Canada; R. W. Rushworth, Baltimore, Md.; E. C. Wiley, Galesburg, Ill.; M. G. Haskin, Detroit, Mich.; Howard Hartzell, Phillipsburg, N. J.

● Craft's Poor Showing

Indicative of something or other (we haven't decided yet) is the fact that, although many different men try their hands at these problems each month, the winners each time seem to be restricted to a certain select group. Now, it's difficult to believe that a knowledge of circuits is confined to men like Wilde of Illinois, Hill of Florida, Perry of Canada, Mervine of Penna., Hinshaw of Idaho and certain others who are consistent winners. Yet we find these names in the winning column month after month, irrespective of the total number of entries.

To say that "these men know their stuff" and let it go at that would be something less than accurate. Yet, there it is. Considering the wealth of circuit material that has appeared in I. P., and the amount of money spent by many Locals for instruction, the results are hardly complimentary to the craft.

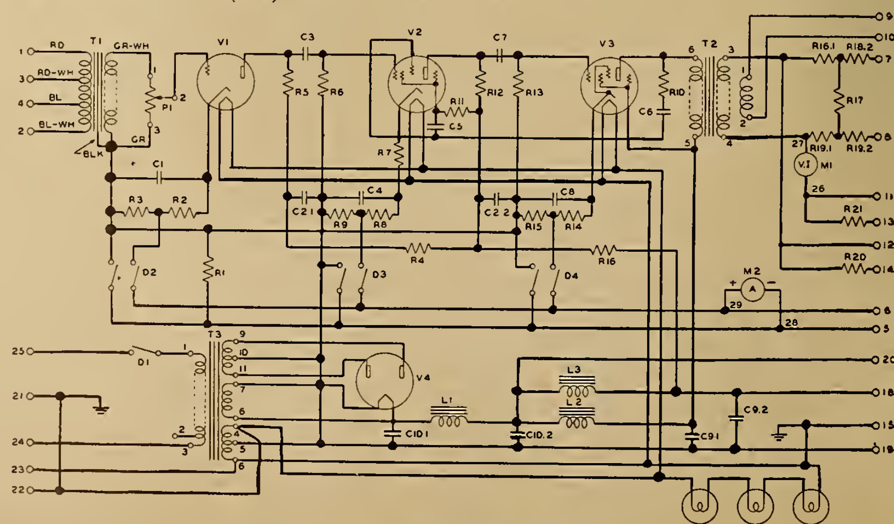


FIGURE 2

FIGURE .1. ***Photograph of picture tube image in England***

FIGURE 2. ***Photograph of picture tube image in America***

The Road Ahead for Television†

By *I. J. KARR*
GENERAL ELECTRIC COMPANY

Television standards having been agreed upon in the U. S., regularly scheduled television programs will be offered soon along with commercial receiving sets. How good will television be and what are the problems—technical, artistic and economic—yet to be solved before television reaches technical maturity? These questions are discussed herein.

FOR several years the public has been increasingly curious to know when television would be introduced commercially, and a great variety of explanations have been advanced by uninformed persons as to why it has not happened already. Of course, at first the reason was lack of technical quality; but in the past few years the quality of pictures achieved has certainly been good enough to interest an increasingly large proportion of the population.

However, two major questions still had to be answered before the widespread commercial introduction of television. The first of these was the fixing of satisfactory television standards and the second was the discovery of a satisfactory method of paying for the programs. The first matter has practically been settled; the second has not.

Television differs from sound broadcasting very markedly in the importance of standards. In sound broadcasting, if the method of modulation (amplitude, frequency, or phase) is once determined, any receiver which can be tuned to the carrier frequency of a given transmitter can receive its program. The technical quality of transmitted programs can be improved year by year, but while this happens, a receiver once purchased is always usable, even though it may become outmoded as compared with current models.

The situation in television is quite different. Due to the use of scanning and the necessity of synchronization between the receiver and transmitter, if transmission standards are changed, receivers designed for the old standards become useless. Because of this fact, no responsible manufacturer would sell receivers to the public until standards were fixed by the industry and sponsored by the Federal Communications Commission. Furthermore, American manufacturers did not desire to fix standards, except at such a high quality that widespread and sustained interest on the part of the public would be assured and so that adequate provision for continued perfection was possible.

● Program Cost Problem

It required considerable technical perfection to justify these high standards, but this has now been attained and the essential standards have been agreed upon. Consequently, it may be said with some assurance that the last technical obstacle in the path of commercial television has been removed, at least as far as the excellence of the picture under proper conditions is concerned.

The question of who shall pay for television programs has not yet been answered. As is well known, the cost of sound broadcasting is borne by "sponsors," who pay enough for their own programs to enable the stations and networks to fill-in the unsponsored time with sustaining programs of good quality and to make a profit in addition. However, this situation now requires the existence of tens of millions of receivers in the country with listeners who may be induced to buy the advertised products.

Such an audience does not exist in television and can not be expected for several years. Of course, no such audience existed in the early days of sound broadcasting either, and the receiver manufacturers themselves, along with a few individual companies who built stations for their own advertising purposes, operated the stations. In those days, however, the thought of something coming through the air, receivable at no cost, was an entirely new one. People were quite satisfied with the new toy as such and program excellence was a secondary consideration. This, of course, meant that the cost of broadcasting (as compared with the present) was low.

Now the public has been educated to expect a high degree of excellence in program material and it is doubtful if mediocre program material in television would be acceptable. This has been quite strikingly proved in England. In other words, when television is born, it must be born full-fledged as far as program material is concerned. This, of course, means great expense which, undoubtedly, will have to be borne by the pioneers.

In Great Britain commercial television is already a reality and it is of interest to consider some of its various

†J. Soc. Mot. Pict. Eng., XXXII (Jan. 1939).

aspects. American television will be quite similar, except for improvements based upon the progress of the art since the British standards were set.

Figure 1 is an unretouched photograph of an image on the screen of a picture tube in England. Fig 2 is a similar picture taken in America.

● U. S. Television Standards

Let us next briefly consider the television standards which have been adapted in this country and the reasons for their adoption. The reader is no doubt acquainted with the general scheme of television used, but a quick review of the essentials may be in order. At both the camera tube and the picture tube, the picture is scanned by an electronic spot (beam of electrons) in a series of adjacent horizontal lines. The number of these lines into which the picture is divided in the scanning process determines the fineness of vertical detail which is reproducible.

After scanning the whole picture, the electronic spot then repeats the process at a sufficiently rapid rate so that no apparent flicker exists. This process is essentially the same, as far as the effect upon the eye is concerned, as that performed by the shutter on a motion picture projector. The frequency of repetition of scanning of the whole picture is known as the *frame frequency.*

In order to conserve ether space, it is desirable to keep the frame frequency as low as possible. Consequently, an artifice is employed in order to increase the apparent frequency of repetition. This device is known as *interlace.* In

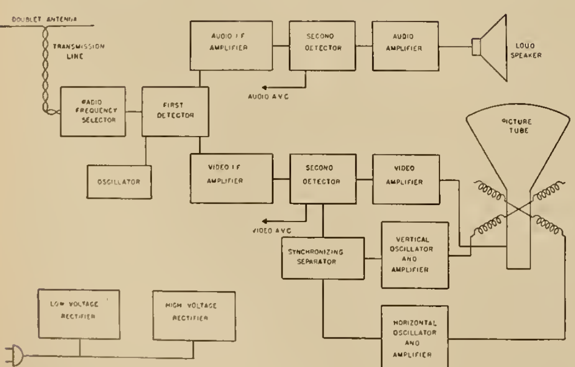


FIGURE 3

Schematic of a typical television receiver

an "interlaced" picture *every other* line of a picture is scanned, and after the whole picture has been scanned in this way, the lines in between are scanned. This gives the physiological effect of scanning the picture twice, as far as flicker is concerned, even though all details of the picture have been completely scanned only once.

The apparent flicker frequency under these conditions, which is twice the frame frequency, is known as the *field frequency.* Now, obviously, if anything other than a complete blur is to be obtained, it is necessary that the number of lines per frame, the order of scanning of the lines, and the number of frames per second be identical at the receiver and transmitter. These accordingly, have been standardized in America as follows:

Number of lines per frame = N = 441

Number of frames per second = F = 30

Number of fields per second = 60 (*interlaced*)

To these we may also add the standard picture aspect ratio, which is 4:3—in agreement with the value used in motion pictures.

There is a reason for choosing the number 441 rather than some other number of about the same value. It may be shown that a necessary requirement for a stable relationship between the horizontal and vertical scanning oscillators, is that the number of lines per frame be a whole number having only small odd factors. Four hundred and five lines per frame is the figure chosen as standard in Great Britain, while in some very fine laboratory pictures shown in Holland, 567 lines were used.

There is also a good reason for using 30 as the frame frequency. It is found that unless the frame frequency is a multiple or a sub-multiple of the power supply frequency, a shadow will move across the picture. This moving shadow has about the same physiological effect as flicker and is very disturbing. However, if the frame frequency is a multiple or sub-multiple of the power line frequency, the pattern of the ripple is stationary on the image and it is much less objectionable. Therefore, since 60 cycles is standard in American power distribution systems, 30 frames per second has been chosen as standard for the frame frequency, since this is the smallest sub-multiple of 60 whose double is above the maximum flicker frequency observable by the human eye.

Among other matters requiring standardization are the synchronizing operations at both the transmitter and receiver. It is clear that scanning at the transmitter and receiver must be exactly synchronous to within an extremely small error. In order to accomplish this, synchronizing signals are always transmitted with the picture signals. The purpose of these synchronizing signals is to start the scanning of both the lines and frames at exactly the right time.

A detailed investigation of synchronizing signals would be out of place here, but it may be stated as absolutely essential that the type of synchronizing signal transmitted should be completely standardized.

The next subject is the frequency channel width required in television. For effective utilization of the intelligence available from a standard television picture, there must be complete and undistorted transmission of all frequencies from zero to at least 2,750,000 cycles. If this signal is used to modulate a radio-frequency carrier, an extremely wide frequency channel is obviously required.

In order to economize on the use of the frequency band thus required, single side-band transmission is proposed. The system may more properly be termed "sesqui-side-band." In this system, the elimination of one side-band is achieved by the use of band-pass filters which have a range of partial transmission in the region on either side of the transmission band. The carrier may be placed on one of these edge bands at a point where there is approximately 50 per cent transmission.

It may be shown that such a system has essentially double side-band transmission for very low frequencies, and single side-band transmission for medium and high frequencies. To return now to the question of utilization of the frequency channel, it is noted that by means of "sesqui-side-band" transmission the frequency band required by the video (picture) signal is reduced by almost 50 per cent.

In transmitting television programs, it has been found desirable to transmit the picture and sound in the same channel. This allows a single oscillator to be used for both sight and sound in a superheterodyne television receiver, thus greatly simplifying tuning. In this system, the sound and sight signals are separated by selective circuits in the intermediate frequency amplifiers. Fig. 3 diagrams a typical television receiver, showing how it transmits and separates the video and audio signals.

When television is discussed by the

public, the questions most frequently asked are, How good is television? How good will it be? and How much will it cost? The answers to these questions involve such matters as: How large will the picture be? How bright will it be? How much detail will it show? How clear will it be? A discussion of these considerations will be of interest.

● The Television Picture

The standard high-quality television system which will possibly be commercialized shortly will have a 12-inch tube with a $7\frac{1}{2}$ by 10-inch picture. Three, 5, 7, and 9-inch tubes will probably also be standard commercial sizes. Compared with the size of a motion picture or even a home movie, these dimensions seem small. However, considering the fact that the audience viewing a television picture will ordinarily not be more than perhaps four feet from the screen (and in the case of the small tubes, even one foot from the screen) these sizes do have considerable entertainment value.

Anyone who has seen good pictures on 9-inch or 12-inch tubes will testify that when the program is interesting, the observer forgets that he is viewing television and becomes completely absorbed in the action on the screen. Nevertheless, it is reasonable to expect larger pictures in the best systems of the future. Table I shows the characteristics of some present-day television tubes.

The matter of increasing the size of the cathode-ray picture presents some serious obstacles. As tubes become larger they also become longer and their overall size becomes such that it is difficult to find suitable cabinets for them, which at the same time lend themselves to attract styling. For this reason, when a 12-inch tube is used, it is invariably mounted vertically in a cabinet, and the picture is seen as a mirror image by the observer. Since a mirror causes a loss of light, and possible double images and distortion. it is an undesirable adjunct at best.

As a further difficulty, as cathode ray tubes are increased in size, they require more driving power, which is expensive, and higher anode voltages, which besides the additional cost, also represents a shock hazard. Thus the prospect of making cathode-ray tubes for home use with screen diameters exceeding 12 or possibly 15 inches does not seem promising at this time.

As an alternate method of increasing the size of the picture obtainable by electronic means, the projection picture tube may be considered. In this case a very brilliant picture on the screen of a 4-inch cathode-ray tube is enlarged by an external optical system and is projected on a screen to a size of, say, 3 x 4 feet. This system requires an exceedingly bright tube with a very fine spot. The ultimate size of projection tube pictures is limited on the one hand by the brightness obtainable from a flourescent screen without causing its rapid deterioration, and on the other hand by the detail which can be obtained, which is closely associated with the fineness of the spot achievable. Projection tube apparatus is probably too large, complicated and costly for home use, but for public performances of television programs it undoubtedly has a future.

Mechanical television systems have also been used for obtaining large pictures, with some degree of success. Of these, probably the most noteworthy is the system employed by Scophony. This system accomplishes modulation of the light-wave by utilizing fringe light, produced by virtue of passing a primary beam through a glass vessel in which is held gasoline or benzine, the liquid being subjected to vibration from a quartz crystal. The resulting modulated wave is then reflected successively by two rotating mirrors at right angles for accomplishing line and frame scanning. In the system as proposed, the line mirror rotates at a speed somewhat faster than 30,000 r.p.m.

● Picture Detail

Closely associated with the problem of picture size is the problem of picture detail. As has been pointed out, the vertical detail resolvable in a picture depends upon the number of scanning lines, and the horizontal detail depends upon the ability of the electrical system to pass extremely high frequencies. In addition to this, of course, neither can go beyond the effective diameter of the electron spot.

Observers have found that if the diameter of a picture element subtends less than one minute of arc at the eye, a picture contains essentially all the detail resolvable by the observer. If the observer is considered to be 4 feet from the screen, a simple calculation will show that there are required 70 lines per inch, and at 2 feet, 140 lines per inch. In present-day high-quality pictures on a 12-inch tube, with a $7\frac{1}{2}$ inch x 10-inch picture, and 400 useful lines,* there are 53 lines to the inch. It is not unreasonable, therefore to expect the number of lines in television pictures to be a matter for attention in the years to come.

Goldsmith states that a high quality motion picture screen has 5,000,000 picture elements. This would be equivalent to a 2000-line picture, which would give 1 degree resolution on a picture 3 feet x 4 feet in size, viewed from a point 5 feet away. While it is not too much to expect such television pictures sometime in the future, certainly a great many problems must be solved first.

For example, such a picture would require 150,000,000 picture elements per second, which, at a conservative estimate, would need a band width of 80 megacycles per program for its transmission. This would undoubtedly require the use of quasi-optical carrier frequencies, and the whole problem would entail development in many fields. To make this statement more striking, the band required would be 80 times as wide as the whole spectrum

TABLE I. ***Some American picture tube characteristics***

Diameter (*Inches*)	Overall Tube Length (*Inches*)	Normal Operating Anode Voltage (*Volts*)	Spot Size (*Lines*)	Type of* Deflection	Type of** Focusing	Remarks
3	$11\frac{1}{2}$	1,500	250	*S-S*	*S*	Green Screen White Screen
$5\frac{1}{4}$	$15\frac{7}{8}$	1,500–2,000	375–425	*S-S*	*S*	Green Screen White Screen
5	$15\frac{3}{4}$	3,000	450	*M-M*	*S*	Yellow-Green Screen White Screen
9	21	6,000	450	*M-M*	*S*	Yellow-Green Screen White Screen
12	$24\frac{1}{2}$	6,000	450	*M-M*	*S*	White Screen
4″ Projection	$14\frac{1}{2}$	20,000	450	*M-M*	*S-M*	Green or Yellow-Green Screen

* *M-M* = magnetic deflection both ways.
S-S = electrostatic deflection both ways.

** *S* = electrostatic focusing.
S-M = combined electrostatic and magnetic focusing.

*Ten per cent of the 441 lines must be considered lost in the retrace interval.

now allocated to all broadcasting in the United States!

Another important consideration in television development is the problem of picture brightness. Cathode-ray tubes used in television receivers at present, are as bright as could be desired in a darkened room. Viewed in the daylight, however, or even in a well-lighted living room, their brightness is deficient. While it is always possible to darken motion picture theatres, television receivers will probably be expected to be more versatile, and to operate in bright light as well.

The problem of increasing picture brightness is being attacked in many ways. Operating voltages for instance can be and are being increased. This, however, is undesirable from the standpoint of safety and cost. More efficient luminescent materials are, of course, the most obvious solution, and such materials are constantly under development.

Another interesting development in this connection is the direct-viewing tube. This differs from the ordinary tube in that the bombarded side of the screen is viewed, instead of the opposite side, as is customary. Such tubes naturally require a construction of unorthodox shape. However, they may be the tubes of the future, both for reasons of brightness and also for reasons of contrast and detail, as will be pointed out later. Maloff reports a direct-viewing tube having a maximum useful brightness of 100 candles per square-foot. This is more than ten times as bright as the highlights in a high-quality motion picture.

● Television Picture Contrast

Finally, there must be considered the matters of contrast and detail. The present contrast available in television tubes is quite good, but much still remains to be done. For one thing a cathode-ray tube exhibits the phenomenon of halation. This is the optical effect of the diffusion of light in the screen material, and with it we may also group the internal reflection of light from the walls of the tube.

Halation is well known in photography. It decreases the brightness of highlights and diffusely lights up points which are supposed to be dark, particularly in locations near the highlights. The general effect is thus to decrease the available contrast and to limit the possible fine detail. The direct-viewing tube is a very effective means of decreasing halation. When such a tube is used, the increased contrast is very striking.

In addition to halation, a cathode-ray tube, also exhibits the phenomenon of "blooming," which is an electrical effect and results in defocusing the spot in the highlights. Improved focusing arrangements can be used to decrease "blooming," but even in the best of modern tubes it still is a problem. Since the contrast desired in a television picture requires an electronic beam of varying density, the focusing of the tube must be so arranged that the focal point does not change with current density, *i.e.*, brilliance. This is not an easy problem. However, it is evident that before 2000-line pictures are ever obtained, great advances must be made in the cure of "blooming."

● Propagation of Signal

The problem of signal propagation in television assumes an importance which, in many respects, is far more serious than that of the corresponding problem in sound transmission. In the first place, the exceedingly wide frequency channels required in television make it necessary that the signals be transmitted in the ultra-short-wave bands. At these frequencies, as is well known, there exists reliably only line-of-sight transmission, since there is no longer reflection from the Heaviside layer. While this fact limits the area of coverage of any transmitter, it is actually very desirable from the standpoint of interference. Thus there is far less likelihood of multiple images caused by multiple path reception, due to reflections from the Heaviside layer, or of interference from a distant station operating at the same frequency, or from atmospheric "static." The only serious sources of noise at these frequencies are those generators within approximately line-of-sight, of which noteworthy examples are automobile ignition systems and medical diathermy machines.

While reflections from the Heaviside layer are negligible, nevertheless, because of the very short waves employed, objects such as steel buildings, water towers, overhead wires, *etc.*, provide efficient reflectors and give rise to "ghost" images. The severity of this problem will be realized much more fully than at present when the general public begins the erection of receiving antennae and the operation of receivers on a large scale.

The line-of-sight limitation greatly increases the difficulty of serving a large geographical area with a given program. 46.6 miles is the radius of the area over which reliable coverage can be obtained from the transmitter, provided that the power of the transmitter is sufficiently great. Consider, now what this transmitter power must be, in order to give reliable reception at the required distance from the transmitter.

● Power Requirements

It is an empirical fact that reliable reception of a television program requires an input signal of about one millivolt. The required transmitter antenna power is 27.4 kw. Actually, at the present time it is not possible to radiate this much power, since no tubes are available to generate it at these ultra-high frequencies.

Using two of the latest high-power developmental tubes in push-pull, it is possible to generate 10 kw. (40 kw. peak) at fifty megacycles. The limiting factor in this case is the fact that the size of high power tubes makes it

Receiver Sale Premature—Zenith Prexy

By *E. F. McDONALD, JR.*

PRESIDENT, ZENITH RADIO CORP.

"The offering for sale of television receivers at this time . . . is in my opinion, unfair to the public and premature, both for economic and technical reasons. Such premature introduction . . . will load the public with undue experimental replacement cost, which in turn, will result in retarding, instead of furthering, development and in unprofitable operations for the companies engaging in such a program.

"I do not believe the radio industry should ask the public to pay for its experimentation in television, at least without putting the public on notice that receivers put out at this time are on an experimental basis and may be subject to many costly changes and replacements.

A 'Stock Proposition' Now

"I still feel . . . that 'general use of television in the homes is just around the corner for the ***stock salesmen only***.' When we have overcome all of our difficulties—and when I say we, I mean the radio industry—television will no doubt become a wonderful new industry. I feel that I am as close to the television picture as the next man, and Zenith is prepared at this time to produce and sell television receivers; but I am not ready to take the public's money until television is . . . ready to provide money's worth . . .

Obsolescence Important Factor

"Television is essentially different from anything with which we have had to deal in the past. The first automobiles . . . sold to the public, unless they have been worn out from use, will still operate on our highways today, and with the gasoline now used. Likewise, the first radio receivers . . . sold to the public will still operate and reproduce programs from the most modern broadcasting stations of today. On the other hand, the television receiving set of one year ago is already obsolete and cannot be operated in the home with the latest television transmitter of today.

"What the public should know, but has not been told, about television is that the receivers must be matched to, synchronized with and built on the same standards as the transmitters. Any major change made in the television transmitter will necessitate a change in the receiver."

impossible to tune them above a certain critical frequency and their high inter-electrode capacities make it difficult to load them properly and still preserve the desired band pass characteristics.

Thus with tubes of the present types, it is not yet possible to reach the desired power level; and the condition will become more serious as more of the still higher frequency channels are used for television. However, it is reasonable to expect that the ingenuity of tube designers will overcome this difficulty in the next few years. In the meantime, the condition can still be corrected by increasing the height of the transmitting antenna, and especially of the receiving antenna.

It requires 12.9 kilowatts of transmitted power to generate a signal of one millivolt in a half-wave dipole 4 meters above the ground at the horizon. This value is independent both of the carrier frequency and of the height of the transmitting antenna. The latter result is very surprising. It indicates that as the antenna height is increased, the same power still suffices to reach the horizon—the increased distance being just compensated by the increased antenna height.

Another problem of considerable importance in the adequate coverage of the line-of-sight area is the elimination of multiple reception or echoes. This problem is of practically no importance in sound broadcasting. To get a clear idea of the problem, suppose that in addition to the direct ray travelling from the transmitting to the receiving antennae there is also a ray which reaches the receiving antenna by way of reflection from a large building. This reflected ray will have travelled a greater distance than the direct ray before reaching the receiver. The picture which it carries will therefore be retarded in time, and it will consequently cause a similar but slightly displaced picture to appear next to the desired picture. This is a very annoying effect, and great effort must be made to avoid it. This effect is illustrated in Fig. 11.

A path difference of 127 feet will cause an echo displacement of one picture element. This is enough to detract from the quality of the picture.

The elimination or reduction of echoes is a complicated problem. In metropolitan areas, due to the presence

(Continued on page 24)

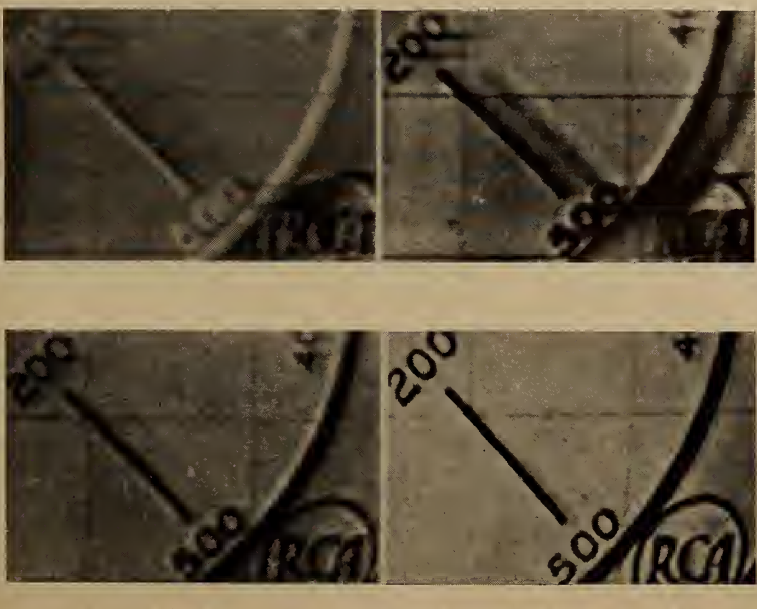


FIGURE 4. ***The effect of multiple-path transmission or reflection upon the received image***

Academy Report on Television Progress

REFLECTING the view of West Coast studio technicians anent present status of television is the third annual report of the Research Council of the Academy of Motion Picture Arts & Sciences, a summary of which is appended hereto.

England led in putting television on a public service basis, inaugurating regular transmission on Nov. 2, 1936. Has made notable technical progress and in quantity and quality of entertainment, but these advances have not been reflected commercially. Present receiver sales are two sound-only sets to one visual set (some of which include sound).

Peak of 4,000 television receivers now indicated for television service area, in which are 10 million people. Public interest has been sustained, with probable extension of coverage promising much wider potential market. Unflagging interest undoubtedly due to visual broadcasts of sporting and ceremonial events, including the Derby, prize fights, tennis matches, boat races, soccer games, *etc.*

Quality of televised image is nowhere near that of 35 mm. film projection, but has reached stage where it can add entertainment value to film houses. Receiver sets range in price from $144 to $756, depending upon image size. Programs broadcast average two hours daily, three hours on Saturdays, and one and one-half hours on Sunday. Present standard of 405 lines, 50 frames per second, will not be changed until end of 1940, thus dispelling fears of receiver obsolescence until then.

Mobile pick-up unit provided, in addition to cable network in desirable sections of London. Coaxial cable laid between London and Birmingham, to be extended shortly to Manchester, although primarily for telephone purposes, may eventually be used for television. Television transmitter has useful range of 50 miles at present.

● Developments in Germany

Experimental station in Berlin utilizes same power as London transmitter, 17 kw, with definition of 441 lines and frame frequency of 50 per second. Two other transmitters are planned. A picture 12 by 10 feet has been shown in a theatre. There are reports of a 700-line image. Cathode-ray tubes up to 26" diameter have been built. Cost of receivers is said to range between $175 and $1,000, with $320 as an average.

● France Relatively Inactive

Eiffel Tower transmitter, rated at 25 kw, more powerful than Berlin or London; its signals have been viewed 180 miles distant. Station transmits daily for 2½ hours. There are reports of a 12 by 9 foot theatre demonstration, with quality approaching 16 mm. projection. No information on receivers or extent of programs.

● Developments in the U. S.

RCA-NBC experimenal transmissions from Empire State Tower (N.Y. City) have continued since July, 1936. System uses 441 lines, 60 frames per second. Home television now regarded as "technically feasible". RCA promises limited program service and marketing of receivers by April 30 next.

Receivers have screens 10 by 7½ inches, too small for convenient viewing, but pictures are bright and sharp and carry sufficient detail to depict emotions, when rather broadly played, in close-up or semi-close-up. Medium and long shots merely show the figures and are used mainly for entrances, exits, establishing settings, etc. In the main, story must be carried with two shots. Film takes of exteriors are sometimes intercut to good advantage.

A member of Academy Research Council who witnessed some of the demonstrations found it difficult to concentrate on engineering features—his attention was constantly diverted to the action. This is as good a test of entertainment quality as any.

Last June several N. Y. department stores demonstrated television reception, using the NBC transmissions. Pictures were mostly in the 5 by 4 inch range,

with receivers priced at $195 to $225. Public interest was aroused, but few sales were reported. Flurry ended when transmitter shut down for adjustments. Real test of public response will come when regular service is initiated and receivers become available in a number of types and sizes.

Engineering developments in the U. S. parallel those abroad. Progress is slow and laborious, but steady. In general, the advances listed above for the foreign field are either the results of American invention, or they can be duplicated here whenever it becomes expedient.

During 1939 a moderate extension of local television coverage is in prospect in various parts of the country. CBS's transmitter will be installed early in the year and begin regular operation. A considerable number of applications for experimental television licenses are on file with the F.C.C.

In Los Angeles, which may reasonably be expected to carry over into the field of television its importance as a radio and motion picture center, a Don Lee station has been televising for some years. Present standard is 300 lines, 24 frames per second, visual frequency, for about eight hours a week, both film and live subjects being scanned. Visual broadcasts of the 1kw transmitter are received as much as 30 miles away.

The Farnsworth system was demonstrated in Hollywood last summer. The picture was in black-and-white and about 9 by 12 inches in size, the image being 441 lines, 60 frames per second. The picture was bright and had considerable entertainment value on the close-ups. Longer shots were not as effective.

● Research Council Conclusions

The long experimental phase of television is about to culminate. The experiment now takes on a larger scope, with the emphasis shifting from technical research (although technical development will simultaneously be intensified) to economic and social aspects. The public, from the role of spectators, will become participants in the project, and on the extent and manner of that participation the effects on the motion picture industry will depend.

That such effects will be evident in the next two years is altogether to be expected. That the repercussions will result in revolutionary changes in motion picture production and exhibition *within that period is unlikely*. The complexity of the television field and the magnitude of its artistic and financial problems are an automatic brake in this respect, and it might be added that this is true of competitive and cooperative potentialities alike.

As regards the latter, when television comes into its own it may well open up a vast market for films especially designed for television distribution. Should competitive factors predominate, it is quite obvious that the strongest interests in the television field cannot afford to ignore their own very substantial stake in the business of aural broadcasting. Although radio is nowhere near the end of its growth, financially it has become a mature industry, mindful of its investment in the present while looking into the future, and this tendency constitutes a protection, if one is needed, for the other entertainment industries as well.

And yet, modern technology has its own dynamic imperatives. It will not and should not stand still. New industries are needed, and if their coming is troublesome, it will be far more troublesome if they do not come. Television is one of them and it is a year nearer.

The situation is one which calls for continual observation and analysis by the motion picture industry, and to an increasing degree as events take their course. The Academy Research Council should *immediately proceed to a more thorough consideration than has been undertaken in the past* of the prospective relationships between television and motion picture production and exhibition.

This investigation should cover the artistic, technical, legal, and economic phases of the subject. Therefore, the Committee recommends that it be enlarged to include representation from those other branches of the industry in a position to contribute a wider background to its considerations.

Television and the Future of the Motion Picture Theatre

By *JAMES J. FINN*

[*NOTE: The appended article is a summary of an address given before numerous projectionist Local Unions in the East.*]

THE question most commonly asked by projectionists anent the television art is: What will television mean to the motion picture theatre? Which is just another way of asking: What will television mean to us, and how will it affect our jobs? It is exceedingly doubtful that anybody can give an accurate answer to this question today, although there are innumerable candidates for the title of "expert". All one can do is to present certain facts that have emerged from the haze of uncertainty surrounding the television art, dispel a few myths—and let the reader draw his own conclusions.

This summary is shy on technical data, these being covered in detail in an article elsewhere herein.

Beginning with pick-up in the studio, television is confronted by precisely the same problems, and more, that are encountered in the motion picture studio—that is, questions of makeup, lighting, costuming, scenery, scenarios, actors and all the other requisites that enter into film production. If film be used as the pick-up medium, as it will be and extensively, these studio problems naturally will not exist. (It is interesting to note, incidentally, that when film is used a Powers 5 to 1 projector movement is utilized, the necessity for a fast movement being obvious.) Outdoor scenes have already been televised, but only under ideal conditions.

● Program Distribution

Program distribution is the major headache of television technical workers at present. The permissable broadcast distance today extends only to the visual horizon, a distance of about 50 miles, depending upon the terrain. This means, then, that a transmitter must be erected every 50 miles, in all directions, throughout the country. Each transmitter would cost about $200,000—thus providing great sport these winter evenings for those mathematically inclined. Two means of effecting a nationwide broadcast network, as it exists in radio today, are available:

1. Coaxial cable, an A. T. & T. development, which is a wire proposition, or

2. Radio relay system, which is straight etherization.

The telephone people naturally prefer that the coaxial cable plan be adopted; while RCA favors the radio relay idea. Of course, assuming that the nation were blanketed by transmitting stations as previously outlined (and what a task this would be, and at what cost!) film prints could be shipped to each transmitter for broadcast. Naturally, this would not constitute a broadcasting network comparable to existing radio networks.

It is a matter of record that the coaxial cable laid over a distance of 90 miles between New York and Philadelphia cost $540,000. What portion of this cost represents engineering development is not known, but we have here an indicated cost of about $5000 per mile. Currently the major radio networks use on the order of 45,000 miles of telephone line to hook-up network programs. Thus by the simple process of multiplying the number of miles, 45,000, by the cost-per-mile, $5000, we arrive at a total cost of a coaxial cable network hookup —and we find ourselves wrestling with an astronomical figure. The cost-per-mile of coaxial cable may be reduced sharply in the not too distant future.

The radio relay plan is wholly feasible, of course, but very difficult and quite costly, although not approaching the cost of coaxial cable. So much for the problems incident to setting up a television broadcast network. Mark well the cost of this job, quite apart from the technical problems involved.

Another extremely serious problem in

television broadcasting is interference, the reflection of so-called "ghost images." Automobile ignition systems constitute a major source of interference, as do overhead wires, steel buildings, water towers, and the like. The automobile ignition problem could be solved with the cooperation of car manufacturers; but the problem posed by buildings, wires, *etc.*, will sorely tax the ingenuity of the best engineers.

● Receiving Set Data

On the reception end, we find that the best sets available (for example, those of RCA and G. E.) will provide an image 10 by 7½ inches and will retail for about $300. These sets will provide an image of greenish tint with a rather low light level. The fluorescent material used in the tube will be improved, of course, but not immediately. It is conceded that the *desirable* viewing distance is between 8 and 10 feet, which would require a picture image of at least 2 feet. Since the image is only 10½ by 7 *inches* (about the size of this page) the maximum viewing distance is reduced to about 4 feet. This not only limits seriously the number of people who can view the image but it also introduces the serious question as to the willingness of the viewers (if more than one) to remain in one position and give fixed attention to the television screen for an extended period of time.

Now, it is entirely possible to enlarge the television image, much as is done in a motion picture theatre with a device such as the Magnascope. As we all know, however, the result of magnification is a decrease in brightness—and brightness is already a serious problem even with the present image of 10 by 7½ inches. Moreover, increasing the image size would necessitate increasing the size of both tube and console, thereby posing another problem.

Another serious problem is that of the general level of room illumination. Must the room lights be extinguished or dimmed away down? If the answer be "yes," then the existing problem of close viewing and fixed attention is aggravated. Another important angle is that television reception is not incidental to normal household activities, as is sound reception.

The quality of present television images might be classified roughly as follows: Close-ups—approximate the quality of 16 mm. home movies. Medium long shots—of fair quality. Long shots—of decidedly mediocre quality and permissable at present only for dynamic action shots such as prize fights, racing, acrobatics, *etc.* Dr. A. N. Goldsmith has estimated that the "sharpness" or definition of a standard motion picture film, as contrasted with the American standard 441-line television image, is somewhere between 1500 and 2000 lines, or approximately four to five times sharper.

Refinement in the art of television is inevitable with the passing of time, and in this connection it is of extreme interest to note that any change in transmitting standards will automatically render obsolete all existing receivers. This aspect of the situation is discussed in detail elsewhere herein, along with other pertinent data relative to the status of the art in this country and abroad.

Admittedly the next two years will be a period of experimentation and development in the art, with no radical changes in its status likely before then. Thereafter it is anybody's guess as to what course television will take. It is entirely safe to say, however, that the biggest problem confronting television today is an economic one, technical progress having reached the stage where regular programs could begin tomorrow if sufficient transmitters and receivers were available. The pressing question of the moment is: Who will foot the bill?

Network sound broadcasting today costs about $30,000 an hour. It is estimated that an elaborate motion picture play, produced along typical Hollywood lines, would add to this figure an *additional cost of* $25,000 *a minute!* while the worst picture that any audience would tolerate would cost an additional $1,000 a minute. No such circuit of first- and subsequent-runs as exists in the motion picture field today would be possible; once a film production had run its course of television broadcasting for about 80 minutes, it would be a cold turkey, finished for all time.

Television, of necessity, has a voracious appetite for material. It is estimated that the present yearly output of all Hollywood studios would sustain a television network for only three months, indicating a quadrupling of film studio output to maintain the art on a broadcast schedule such as is adhered to in radio today. Herein lies Hollywood's great opportunity not for survival but for progress on a scale hitherto undreamed of—that is, if the producers keep their eyes peeled and are not blocked out of the play either by unpreparedness in general or, specifically, by those peculiar clauses in their sound recording contracts with the electrics which restrict the use of any picture the sound for which was recorded on their systems. This means in simple language that such pictures cannot be used for television.

● Public Expects Quality

Persistent and colorful publicity reciting the wonders of television have led the general public to expect extraordinary things of the art—not only in the way of quantity in the form of long daily schedules, as in radio today, but also quality as to size and content of the image. Keen disappointment will ensue when the general public discovers that the television image is not 2 feet but rather less than 1 foot. It is all very well to say that novelty will sustain the art in its early stages, but this wishful thinking will evaporate should the "early stage" lengthen into months or, possibly, a couple years.

Once a television service is launched, not even staggering costs, insufficient support by advertisers, or definite lack of interest on the part of the public will justify any discontinuance of the broadcasts, or even a "temporary" suspension. The television people understand this requisite perfectly well, which is why they insist that the art be ushered in full-blown, so to speak, and maintain a steady pace.

● Effect on Film Theatres

But what of the effect of television upon the motion picture theatre? The writer has never subscribed to the opinion that television will be utilized in theatres. It is his opinion that television, like the present radio broadcasting, is strictly a product for the home, because this is the only possible way in which the broadcasters can interest advertisers, who, after all, are expected to pay the freight. Why, the writer often asks, should anybody go to a common gathering place, such as a theatre, to witness a television program that can be viewed with much more comfort right in the home? Possible exceptions to this premise would be the interpolation *in a film program* of televised spot news of widespread interest, particularly of sporting events. But a straightaway television theatre? Never! There is no valid reason for it.

If this estimate be correct, then the competition for patronage will lie between the motion picture theatre as such and television in the home. Considering the difficulties which beset the progress of television as enumerated herein, it is extremely doubtful that the art will enjoy any considerable audience for a couple years at least. After that the issued will be joined. But television positively is not the ally of motion picture exhibition—far from it—anymore than radio is an ally today. In fact, both of these arts are stiff competitors, due in large part to the stupidity of an industry which permits its ranking talent to clutter up the air waves nightly, to the number of 24 of a recent Sunday.

The motion picture theatre, to survive as such, must remain just that and must be the beneficiary of drastic overhauling of the present industry structure and *modus operandi*—beginning in Hollywood. Double features should be eliminated in the interests of fewer but very much better pictures. The Hollywood economic setup must be radically revised, particularly with respect to star salaries and the nepotism that is rife in that alleged citadel of culture. Payment of $150,000 per picture and more to individual performers who don't draw even flies to the box-office must be stopped, so that picture costs can be slashed.

Distribution methods should be overhauled. Distributors should stop robbing exhibitors on percentage pictures. In what other industry in the world, outside of the prize fight racket, is a commodity offered on the basis that a distributor reserves the right to pry into a retailer's business and exact a given

(Continued on page 22)

Technical Data On New RCA Sound Systems

SIX new sound reproducing systems, which incorporate more than a score of technical advances, have been announced by RCA Photophone. Tone quality that imparts "studio presence" to the reproduction, greater convenience of operation and streamlined functional design are some of the improvements ascribed to these equipments, which are the culmination of more than a decade of research and development.

The new equipments have been designed to fit the sound reproducing requirements of every size and type of theatre, ranging from super-theatres down to the smallest neighborhood houses.

To Photophone's famed rotary stabilizer has been added a shock-proof drive mechanism; together they insure perfectly constant film speed past the reproducing photo-electric cell, thus eliminating any possibility of distortion from this source. A double exciter lamp unit provides an emergency spare lamp for instantaneous changeover in case of failure. The optical focuser on the new equipments are securely locked into place after adjustment. Gear failures are virtually eliminated by an integral gear box assembly built into the new soundheads which keeps gears running in an oil bath.

● Quality, Utility, Durability

All housings for the soundhead, amplifier racks and volume control box have been completely restyled, evidencing a new functional streamlining which not only improves the appearance of the equipments tremendously but also assures the utmost utility of every component.

The new sound systems have been engineered, designed and built to set new standards of quality as well as of operation and convenience. Standby facilities have been provided to relieve the fear of possible breakdown. Both the styling and improved operating convenience should be especially welcomed by projectionists. Double appeal is exerted by these new systems: to the ear and eye through outstanding performance and appearance; and the kind that is built into the apparatus to give dependable, trouble-free service over its full life.

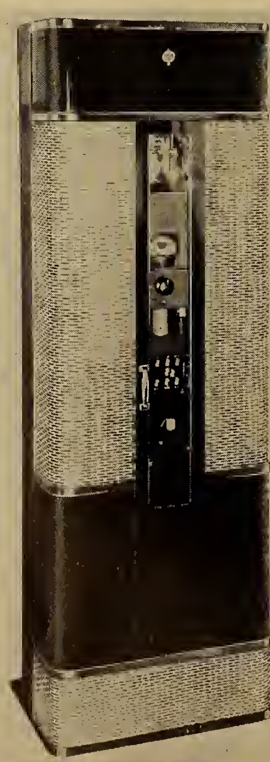
Photophone hails the shockproof drive for the constant-speed sprocket shaft as its most important laboratory development since the introduction of the rotary stabilizer. The new drive makes it impossible for gear backlash to be transmitted to the constant-speed sprocket, thus insuring absolute constancy of film speed. The drive mechanism is mounted in the new type of integral gear box in such a way that it can be removed easily as a unit for servicing or replacement. The sound bracket assembly, including the optical system and the drum shaft, can also be removed in one piece.

An improvement which will be favored by projectionists is the double exciter lamp. If one light fails, it is only necessary to turn the socket around, and the spare bulb goes into operation immediately, while the burned-out one can be renewed as the show continues.

● Other Important Advances

RCA points to the new self-locking focal adjustment mechanism as a long step toward improved operation. A light shield in front of the optical system avoids 96-cycle hum resulting from modulation of the sprocket holes in the film. A new type of pre-focused exciter lamp bulb has been utilized, doing away with the necessity for adjusting the lamp laterally.

The new soundhead has a smartly styled housing over the electric driving motor, giving the equipment a clean-cut appearance never before achieved. This cover, like all the others on each piece of equipment, is easily removed for inspection or servicing. On the right side of the soundhead is a glass window which permits a view of the interior. It is illuminated at the edges, eliminating glare and permitting a clearer view of the interior.



The new Photophone amplifier rack is trim and compact and provides easy access for checking or repairs

The photo-electric cell transformer has been entirely shielded in a cast iron chamber in the soundhead, insuring virtual absence of noise from static in the soundhead, another improvement new to this equipment.

A completely new system of mounting the picturehead in the soundhead has also been devised. A separate removable plate is provided atop the soundhead to which the picturehead is fastened. It is then only necessary to remount the removable plate on the soundhead, securing it with four screws on the outside. This contrasts with the older method of running long unhandy bolts from the picturehead into the soundhead. The removable plate also serves as an oil collection plate, gathering oil drips from the picturehead and feeding them into a tube which empties into a removable container.

The mounting plate is also designed to provide easy adjustment of the picturehead in relation to the soundhead for the proper meshing of the former's drive gears.

The price range of these new RCA systems is: for theatres of up to 800 seats, Model 138, $1375; up to 1200 seats, Model 139, $1650; up to 1800 seats, Model 140, $2250; up to 2600 seats, Model 141, $2850; up to 3800 seats, Model 142, $3375; and for houses up to 7000 seats, Model 143, $3800.

HARRY BROOKS' SHRINE HONOR

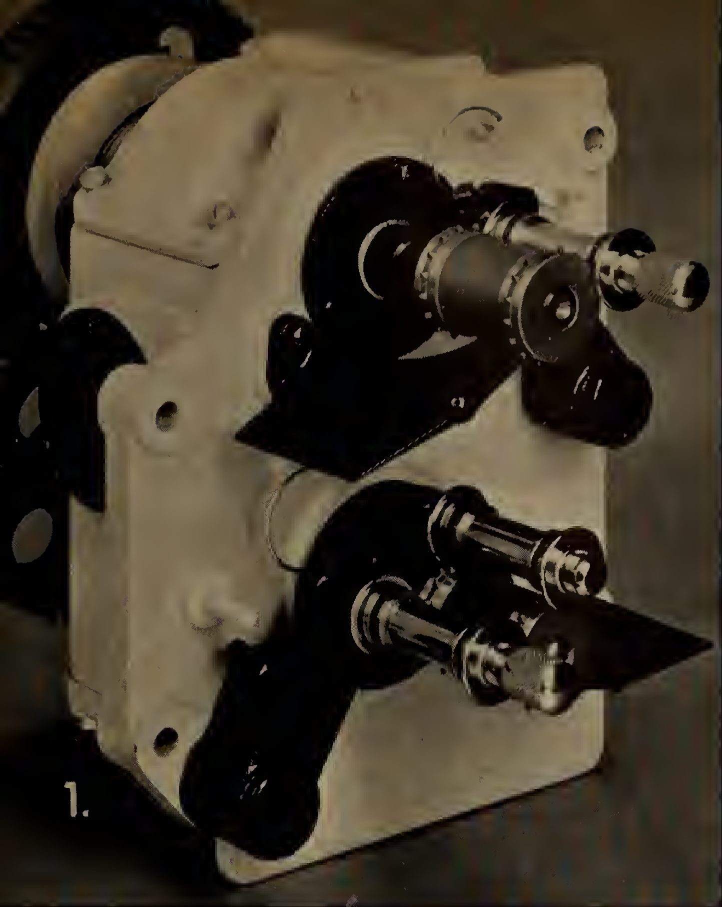
Harry M. Brooks, well-known in national I. A. circles, has been elected Illustrious Potentate of Oriental Temple, A.A.O.N.-M.S., of Troy, N. Y. Brooks is now serving his 29th term as President of Local 285, Troy, is a former member of Local 29, a past-president of the N. Y. State Assoc. of Projectionists and present Sec.-Treas., in addition to serving on the 10th District legislative committee. He trouped for 12 years as a stage carpenter.

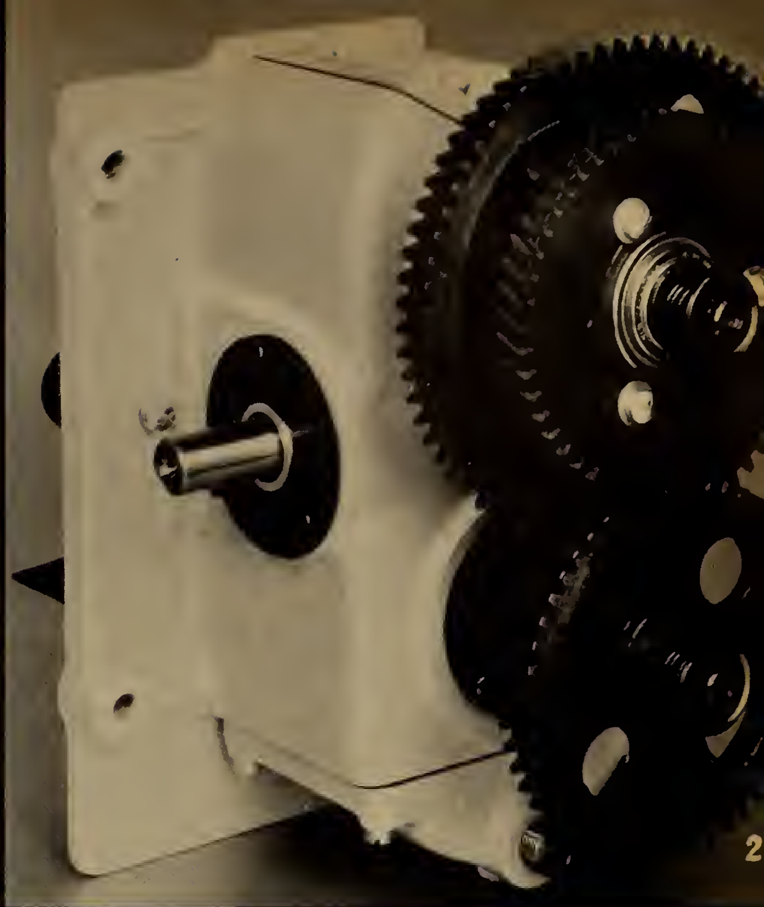
BOSTON LOCAL 182 ELECTION

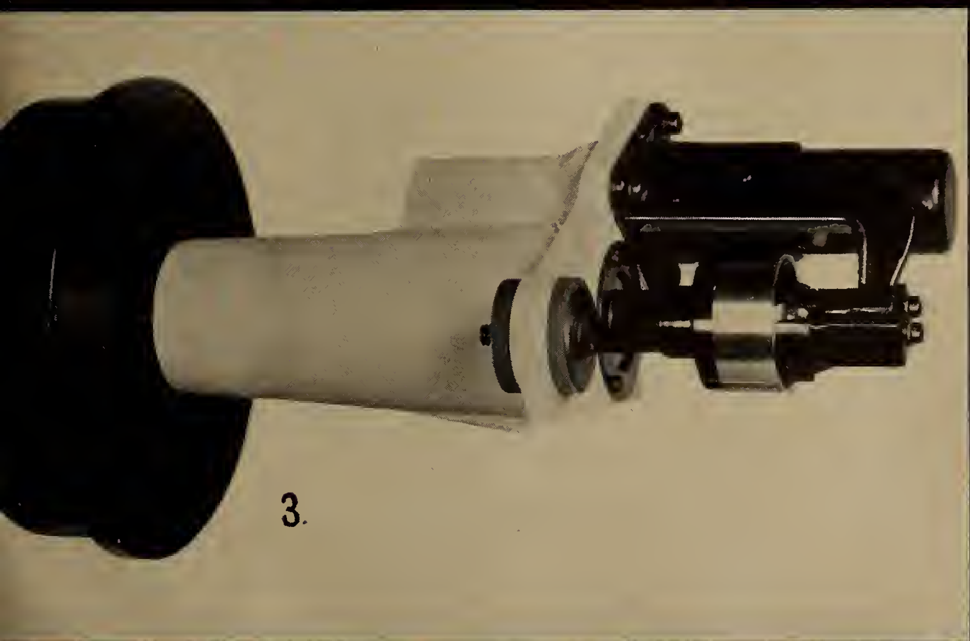
This isn't a news item, but we print it every year simply for the record. Thad Barrows and Jimmy Burke have been re-elected president and business representative, respectively for their 21st consecutive terms. Other officers of Local are Bernard McGaffigan, vice-president; Al Moulton, financial secretary; Joe Rosen, treasurer; and to the executive board: Louis Pirovano, Joseph Nuzzelo, John Diehl, and James O'Brien.

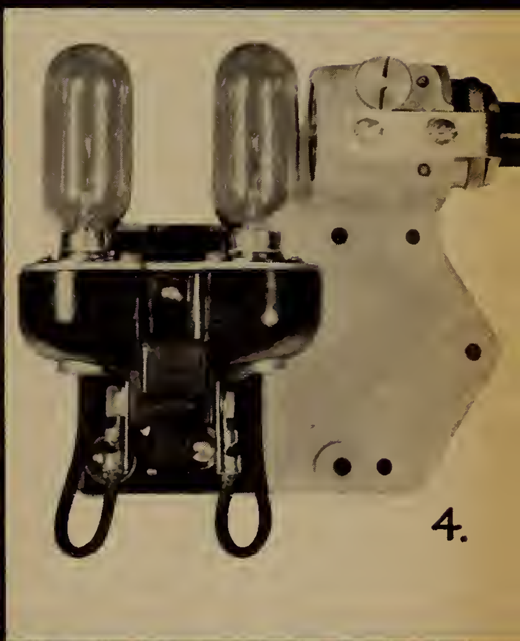
U. S. CONTROLS DUFAYCOLOR

Dufaycolor, Inc., which on Jan 1 passed from English hands to exclusive operation and management by a private financial group in the U. S. will henceforth conduct business under the name of Dufaycolor Co., Inc., with offices at 30 Rockefeller Center.









1. The new integral gear box assembly which keeps the gears in the new Photophone soundhead running in an oil bath and makes gear failures virtually impossible. An oil indicator tells the projectionist when additional lubricant is required.

2. This is the mechanism which provides the new shock-proof drive for the rotary stabilizer in the new soundhead. Isolation of the constant-speed sprocket shaft and drive gear from the gear train and driving apparatus prevents gear backlash from being transmitted to the constant-speed sprocket. Absolute constancy of film speed is therefore assured.

3. The RCA rotary stabilizer which is an integral part of every Photophone soundhead. Its efficiency has been increased still further in the new sound systems by the use of a new shock-proof driving mechanism which isolates the stabilizer itself from all vibration or gear backlash. Film flows smoothly and steadily past the light source.

4. Two new developments in the Photophone soundhead are shown here. In the front is the double exciter lamp socket, which makes a spare lamp ready for immediate use by simply reversing the socket. Also shown is the mechanism for focusing and locking the optical system (right). The lens can be focused quickly and accurately by the projectionist and then locked securely in place.

Television and the Motion Picture Theatre

(*Continued from page* 19)

portion of the latter's income as against a minimum flat guarantee? But do the distributors offer to make up the deficits of the innumerable "ham" pictures of B, C, D, E and F grades?

The exhibitor just must be given a chance to make some money so that he can refurbish his house, employ the best mechanical facilities, better sell his film program and do in ever so much better fashion the many other things essential to the successful conduct of a theatre.

More money must be alloted to the industry's technical forces so that pictures can be improved. Strenuous efforts should be made to improve color films and to bring out of the laboratories new developments—such as stereoscopic motion pictures—to the end that the industry may be better armed to fight for its share of the entertainment dollar. Someone well versed in both the motion picture and electronic arts (the writer can think of no better nominee than Dr. A. N. Goldsmith) should be appointed to look into the technical, economic and legal aspects of the relationship of motion pictures to television. This is a "must" procedure.

The exhibition field must be accorded every aid in what will develop into a battle for its life. If the aforementioned steps are not taken, and shortly, the film theatre field is doomed.

The opinion has been advanced that man being a gregarious animal is an important factor in the theatre's favor in its battle for patronage against visual-sound broadcasting. Certain it is that people will not be expected to huddle around a television receiver in a semi-darkened room and give fixed attention to a comparatively small moving image hour after hour, night after night; but it cannot be denied that anything that tends to keep people in the home is bad medicine for film theatres. Watch a few box-offices these Sunday and Thursday evenings.

● Opportunity for Labor

The greatest enemy of the film theatre today, apart from the policies pursued by the industry itself, the writer holds, is bridge. Before you laugh just stop and consider what a hold this strictly home game has on millions of people in this country. Next in order as box-office poison are the innumerable chance games flourishing in many cities, in the very forefront of which are the churches which resound to pious platitudes Sunday morning anent the evils of the flesh and gambling, while in the evening the walls echo and re-echo to the lingo of Bingo and Bango. Just as an example, in the city of Cleveland the nightly Bingo games are estimated to draw an attendance of about 70,000 nightly, with games running rampant in every block.

Such things as this are the concern of everybody in the industry, and a conference of producers, distributors, exhibitors and Labor to consider how best to attack the problems posed by all forms of box-office poison would be not at all amiss.

Projectionists and stagehands should do all right in the television field itself. Television, if handled properly, is just a wooly lamb ambling down the street and just waiting to be shorn. In Radio City, New York, there are today six motion picture projectionists employed. Since motion picture film will be extensively used in television broadcasting, it seems safe to say that there will be about 3000 projection jobs in television stations; and on a three-shift basis this number may run as high as 5000. This is plenty of jobs in any language. How this angle develops will depend in large measure upon how swiftly and efficiently Labor moves in upon the television field, a topic which is not for discussion herein. Nobody in the television field will say "No" to Labor, because the stakes are too big.

To repeat: What will be the effect of television upon the motion picture theatre? The writer's opinion is that, after two years or so, it assuredly will do the theatre field no good, but the extent of the damage can be held to a very small total if only the picture industry will bestir itself promptly to save its own life. In short, the answer to the foregoing question is in the lap of the picture industry itself, from the most noted producer in Hollywood right down to the doorman of a small-town theatre.

Wall St. Estimate of 1939 Film Business Prospects

The *Wall Street Journal* in its yearly forecast edition dealt extensively with the film business. Key sentences from the leading article:

"The movies probably will have a much more profitable year in 1939 than in 1938, which might be called a year of expiation."

" . . . the combination of lower expenditures and higher income probably will result in first half profits nicely ahead of a year ago."

"It begins to look as though a lengthy process of revamping and readjustment of policies and methods of doing business is just beginning to get under way."

"Hollywood has made the error of believing that money can be used as a substitute for brains, talent and hard work."

"The industry is also probably carrying the load of too many pictures."

"Another trend that may have important influence on the industry is the growing movement toward producing good Class B films."

Favor Theatre Divorcement

" . . . it is interesting to note that last year the only producing companies that made substantial profits from the film division of their business were those that had the fewest theatres."

"*It may be assumed from this that theatre chains are not essential to the effective operation of a film producing company and that the industry might be benefited in the long run by the divorce of the production and exhibition divisions.*"

"At least one management is understood to be perfectly willing to separate these two divisions, and eventually may take action along this line, even if not compelled to by the courts."

Erpi Foreign Department Deal on all Room Equipment

Negotiations are in progress between erpi and leading American manufacturers for the distribution, by erpi's foreign distributing companies, of complete projection room equipment in approximately fifty foreign territories. "Because of a pronounced tendency on the part of exhibitors in foreign countries to prefer transacting business with some one establishment when purchasing such equipment," the announcement states, "Erpi will begin distributing a complete line of projectors, lamps, screens, converters, *etc.*, American manufacture. In the past our foreign organizations have handled only W. E. sound equipment, but expediency has caused us not infrequently to handle other kinds of projection equipment."

G. E. Process Removes Glare, Reduces Light Loss

Glare from reflected light, which has made it difficult to see pictures framed under glass at certain angles, has been removed by a new process developed by General Electric. Similar results are obtained any place where glare is caused by light reflections on glass. The process still is in a laboratory stage.

The refractive index of any type glass is easily determined. This known, the process consists of building or attaching to the glass a very thin transparent film of about four millionths of an inch, or exactly one quarter wave-length of light, in thickness. As light falls upon the film, rays are reflected from both the upper and lower surfaces. With the film exactly one quarter wave-length in thickness, those rays coming from the outer or upper surface are equal in intensity and opposite in phase to those rays reflected from the lower surface, thus counteract one another and no light is reflected.

We can measure or determine the exact thickness of the film at any time, although it may be thinner than any substance we know of today, by an optical process.

See Widespread Application

The non-glare treatment of glass also promises to have a wide spread application with all other type lenses. It is commonly known that reflection from the surface of any lens causes from 4 to 5 per cent loss in the light transmitted. Since this is true of both front and back surfaces, there is a light loss of at least 8% in each lens. With some of the better type cameras, using three or four lenses, the loss of light reaching the plate or negative is 25 to 35%. With telescopes and submarine periscopes, where a larger number of lenses and prisms are used, the light loss is still greater. In some periscopes it is as much as 75%.

With the exception of the slight loss by absorption in the glass itself, the film-treated lenses would transmit 100 per cent of the light. In an actual laboratory test, a piece

of glass was treated and by doing so we increased the light transmission from 92% to 99.2%.

WOMEN EVALUATE MOVIES

Seventy-seven per cent of all women think movies are becoming more entertaining, it was disclosed in a nationwide survey by the *Ladies' Home Journal.* No movie during 1938 was offensively vulgar, 89 per cent of all women declared.

Women as a whole were evenly divided on the question of whether movies should show scenes of women drinking, but 66 per cent of the farm women and 62 per cent of the small-town women did object to such scenes. There was a similar difference of opinion on movie scenes of women smoking. While 62 per cent of all women had no objection, 57 per cent of the farm women and 50 per cent of the small-town women disapproved.

Ninety-one per cent thought children under 14 should be allowed to go only to recommended movies, and 69 per cent would not permit them to see more than one movie a week. By a small majority—57 per cent—American women said there was no objection to having advertising of products shown on the screen.

STANLEY, TECHNICOLOR PROFITS

Stanley Co. of America, subsidiary of Warner Bros. Pictures, reported a net profit, after all deductions, of $2,063,703.

Technicolor reported a net profit for 1938 of $1,200,000, more than double that of 1937. Yearly dividend was $1.

N. Y., CONN. FULL CREW BILLS

Two men shift legislation has been introduced in the legislatures of New York and Connecticut. The N. Y. bill, applicable only to the four first-class cities in the State, also provides for the exclusion from the projection room of all persons other than licensed projectionists while equipment is operating. Sixth consecutive try for the Conn. bill.

MOVIE QUIZ FLOPEROO

Motion Pictures Greatest Year Campaign, including $250,000 Movie Quiz Contest, is generally regarded as the biggest egg ever laid in the industry, judged from any angle, but particularly from that of box-office returns.

SERVICEMEN IN DETROIT LOCAL

Theatre sound servicemen were taken into Detroit Local 199 for the first time recently. Batch inducted numbered seven men employed by Altec and RCA.

A. P. S. INSTALLS OFFICERS

Officers of American Projection Society, of N. Y. City, for the ensuing year are: Pres., E. McD. Bendheim; v.-p., A. R. Bishop; Sec., F. McMahon; Treas., J. Ambrosio; Sgt. Arms, J. Chulchian. Board of governors is A. Polin, E. Ferris, E. Levene, F. D. Smith, T. Rugino. The A. P. S. was the first technical organization in the field, being organized in 1914.

P. A. McGuire, long an honorary member of the Society, for the sixth consecutive year installed the officers.

CAPITOL SUPPLY ANNIVERSARY

Capitol Motion Picture Supply Corp. of N. Y. City has just observed the twentieth anniversary of its founding. Under the direction of I. Perse, this house has served projectionists and exhibitors efficiently and equitably, its major concern having been and continues to be the prestige of its name.

OFFICE BUILDING PROJECTION

Installation of visual and sound projection facilities in all office buildings, modern or otherwise, is forecast by Eric W. Haldenby, prominent Canadian architect, as an aid to modern merchandising. Air-conditioning and sound-proofing having only recently gained widespread recognition as aids to greater human efficiency, said Mr. Haldenby, it is only natural that business should explore the electronic arts as a further step forward.

J. FRANK BROCKLISS DEAD

J. Frank Brockliss, 59, internationally known distributor of motion picture equipment died recently in London, England. Formerly engaged in film distribution with Metro-Goldwyn and with First National in London and in Paris, Brockliss in recent years devoted all his time to the supply house which he founded.

TELEVISION'S ROAD AHEAD

(*Continued from page* 17)

of many reflectors in the form of tall buildings, the problem is serious indeed. The usual solution is to use a directional antenna which will discriminate against the undesired signal. Horizontal polarization of the radiated signal has been found to improve the signal-to-noise ratio at television carrier frequencies, and its use will therefore probably become a standard practice.

● Network Problems

Some of the problems connected with the chain distribution of television programs may now be considered. There are two general methods which have been used to transmit television programs from a key transmitter to a distant transmitter. These are the use of (1) The radio relay or (2) The coaxial (or other) high-fidelity cable relay.

Whichever method is used, the relay stations must be sufficiently close together so that non-fading, noise-free signals are received at each repeater location. It has been found that relay stations must be located from 30 to 70 miles apart, the exact distance depending on noise conditions and (in the case of the radio relay) on the topography of the landscape. It has been customary to operate radio relays at wavelengths of two meters or less. Each relay station, of whichever type, must reproduce the incoming signal with the highest fidelity, having neither amplitude, frequency, nor phase distortion. In other words, the picture must not be degraded in passing through the relays.

● Major Problem is Cost

It is not surprising that the great problem in the relaying of television signals is cost. The cost-per-mile of a coaxial cable required to handle the exceedingly wide frequency bands of television programs is, at the present time, many times as great as the cost of corresponding networks used in sound broadcasting, both as regards initial cost and maintenance. If radio relaying is used, the cost of the relay transmitters required is obviously very great. However, the coming years are likely to bring great reductions in the costs of both methods of relaying, particularly the coaxial cable.

This paper has been an effort to point out the fact that many problems still must be solved before fully satisfying television pictures will be available in the home. However, it is not to be construed that the commercial introduction of television will await a solution to these problems. Undoubtedly television will be commercialized in the near future and the problems will be solved as time passes—much the same, for instance, as was the case in the motion picture industry. One fact is very clear, that the further development of television must come largely through findings in the field, that is, by actual trial.

Discussion:

Mr. McNabb: Referring to the reproductions of a British picture and an American picture, the line structure was quite evident in the British picture, but the contrast seemed a little better. Is the contrast better in the British picture due to the method of transmission, or is the transmission of direct current along with the signal better than the American method of adding the d.c. at the receiving end?

Mr. Kaar: There is no essential difference in the method of transmission in England and here. The only difference is the means of synchronization. As far as contrast and detail are concerned, there should be no difference between the two systems except for the possible fact that we have 441 lines whereas they have 405.

It is possible to photograph any kind of picture from the front of a picture tube and we can so adjust focus and contrast as to make the line structure visible on an American picture.

As a matter of fact, neither of these pictures is a good example because they have both been degraded by photographic processes in the original photograph, the enlargement, the negative, and the lenses, so in order to compare the two fairly the originals should actually be seen. Our pictures are somewhat better than the British pictures.

Mr. Finn: In the choice of repeaters, Mr. Kaar suggested that the choice as between coaxial cables and straight etherization of a program is very close. Is it your suggestion that the coaxial cable be used, over hill and dale for thirty or sixty miles,

throughout the whole broadcast circuit, to blanket the country?

Mr. Kaar: That is a difficult question to answer because I am not familiar with the recent progress on coaxial cable. You will find a description of the New York-Philadelphia cable in the literature. As I remember, it has repeaters every ten miles and as yet will not transmit the full band required. Perhaps some day transcontinental cables may be laid capable of handling television programs, but I can not say that they will. The other system is satisfactory and has been tried. As to the economic balance between the future use of cables and ether channels, that still remains to be answered.

Mr. Goldsmith: The New York-to-Philadelphia cable was said to have cost $540,000. Whether that included large engineering developmental expenses or not, it is not known. In any case, that would have indicated a per-mile cost of $5,000 or $6,000. The major broadcasting networks in the United States today use somewhere on the order of 40,000 or 45,000 miles of lines, and if one multiplies that by $5,000 for the cost of laying a similar coaxial cable network, the result of the multiplication is an extremely large and uneconomic amount.

However, it is believed that development will lead ultimately to less costly coaxial cables with repeater stations closer together and satisfactory for the purpose, or to economic radio relay systems that will work very effectively.

Mr. Kaar: The fact that such a serious problem exists in chain programs comes pretty close home to the motion picture engineer, because for the immediate present there is an answer to the chain broadcasting of television programs, namely, the transmission of motion picture films, which will undoubtedly be done extensively.

Mr. Goldsmith: There are many practical and artistic reasons why film will necessarily be widely used.

Mr. Williford: Does the adoption of the 60-cycle frequency as standard mean that communities having 25- or 50-cycle power supply are definitely out of the picture as far as television is concerned?

Mr. Kaar: There is no connection between the synchronizing mechanism of television and the power frequency. The synchronizing is accomplished by transmitted signals. The only reason and the advantage of choosing a frame frequency that is a multiple or submultiple of the power-line frequency is this: If a system should develop a ripple, as we know it in audio work, that ripple would occur at power-line frequency. If the frame frequency occurred at some other frequency than that, this ripple, which would be either a light area or a dark area, would travel across the screen. If the system is perfect and there is no ripple, it makes no difference at all. This is simply chosen as a safety measure.

Mr. Goldsmith: If the power-supply system of the receiver and its shielding are so engineered that no such effects appear, the receiver can be used equally well regardless of the power supply.

Mr. Cable: It seems to me that the frequency chosen as 30 places a definite limitation on the picture brightness, because frequency is a function of brightness.

Mr. Goldsmith: The present standard is 60 pictures per second. We see 60 "half pictures," with interlaced scanning. First is shown a picture with lines 1, 3, 7, and so on, as a full picture; and the one with lines 2, 4, 6, 8, and so on, as the next picture, a sixtieth of a second later. So the frame frequency is 30 but the field fre-

quency is 60 per second. You substitute for picture flicker a new effect called interline flicker, which is practically invisible.

Mr. Friedl: I see a lack of uniformity among the standards adopted by Germany, Great Britain, France, and America. Inasmuch as the number of lines selected is 441, which has been selected mainly to allow room for improvement, can not we look forward to transmission across the ocean, and, therefore, international standardization?

Mr. Goldsmith: We may hope for this, because some such standard as 441 lines for the picture might be adopted by all the nations. But it must be admitted that at the present time radio differs from motion pictures in that international standardization is rather conspicuously absent.

Mr. Friedl: We are conscious of the high voltages in the larger tubes—25,000 and 40,000 volts. What is the voltage on the 12-inch tube and how does the system meet with the protective requirements of the NFPA and the Fire Underwriters?

Mr. Kaar: The voltage on the 12-inch tube will probably be 6000 volts. That sounds like a very serious matter, but really it is not. If you sit in a dentist's chair and he turns the X-ray on you, that is about 40,000 volts. It is protected. It simply means we have a job of protecting the television receiver, possibly by an interlocked back.

Mr. Friedl: All I can say is that conditions in the home where children might come in contact with the apparatus are different from what they are in a dentist's office.

Safety Features of Console

Mr. Goldsmith: The back of the receiver is expanded metal mesh. If you open the back, you will open all power circuits and discharge the high-voltage condensers automatically. If you try to take the cathode-ray tube out you will similarly open up the circuits. You can not get into contact with a high voltage. It is generally so arranged that even people with screwdrivers and determination simply can not get into trouble, and we hope these practices will continue.

Mr. Friedl: Does horizontal polarization mean that the antenna will be horizontal? Also, is that discussion of a three-meter receiving antenna going back to a multiplicity of "wash line" antennas on every roof?

Mr. Goldsmith: The antenna wire or rod is only about six feet long. The two component rods are each about three feet long.

Mr. Kaar: They are half a wavelength long, and the wavelengths are of the order of five meters.

Mr. McNabb: It was the opinion of certain American engineers who investigated the British pictures that the British were ahead of us in their technical developments as well as their commercial exploitations of the art. That seems to disagree with the opinions of other American engineers. Exactly what are we to believe?

Mr. Goldsmith: The consensus of engineering opinion among those who have seen television pictures in London and New York is that there is little if anything to choose between them. It is most unlikely that practice in either case is far ahead of the other.

Twelve projectionists either burned to death or permanently disabled is 1938's record in a "non-hazardous" occupation. Oklahoma courts please note.

• • •

Comes now after all these years a group which repeatedly requests that I. P. reconsider on the basis of present performance its disapproval of Mir-O-Guards. We'll do it; with publication of our findings to follow, as usual.

INTERNATIONAL PROJECTIONIST

FEBRUARY 1939

VOLUME 14 • NUMBER 2

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Edited by James J. Finn

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Monthly Chat

RELIABLE estimates place the number of theatres still using low-intensity projection at about 8,000. Granting that this figure is correct, indictments are in order for both the merchandisers and the ultimate users of the Suprex arc. Equipment distributors report that the cost of two lamps plus conversion units represents a sum which most small theatres are unable or unwilling to expend. Exhibitors add still another objection, that relating to increased operating costs for Suprex over l.-i. equipment, their contention being that the advertised "few cents per hour" extra cost actually may run as high as ten cents. This matter of operating costs merits examination by some impartial group—and the basis for such investigation should be not the minimum but the ideal operating conditions.

Whatever the reason for the failure of Suprex to make a deeper dent in the exhibition field, it is an industry disgrace that 8,000 theatres catering to the largest number of steady moviegoers are offering projection the result of which is highly unsatisfactory with black-and-white prints and positively horrific with color prints.

Incidentally, we notice in our travels that many Suprex arcs are being operated far above approved ratings. About 48 amps. for the smaller and about 60 amps. for the larger trims are the correct figures. We've seen these figures exceeded by more than 10 amperes—all to no purpose other than the waste of juice and carbons.

• • •

OUR presentation over the past few months of copious data relative to the present status of television seems to have cooled many a projectionist brow that has been highly feverish as a result of foreseeing the passing suddenly of the motion picture theatre. Not that any attempt was, or will be, made to minimize the probable unfavorable effect of television upon the exhibition field; not at all. But the facts as set forth herein did serve to dispel in great measure the widely-held view that "television just around the corner" constituted a death warrant for the film exhibition field within a very few months.

That television is a potential formidable competitor for the motion picture theatre there can be not the slightest doubt (although it seems likely that the studios will be busier than ever providing network product); yet the exhibition field can do much to improve its present position and thereby minimize the ill effects of television competition if it will only take the necessary steps.

Meanwhile it is again in order to warn projectionists against the numerous television "schools" which are sprouting all over the country. Those men who know their sound-picture stuff should have no difficulty in grasping the what, how and why of television when the proper time arrives. That time assuredly is not yet.

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INTERNATIONAL PROJECTIONIST

VOLUME XIV NUMBER 2

FEBRUARY 1939

An Analysis of Brush Operation on Commutating Equipment

BY ENGINEEERING DIVISION, NATIONAL CARBON COMPANY

BRUSHES on commutating equipment have three distinct functions to perform. First, they must carry the load current to and from the rotating element of the machine, the armature; second, they must resist destructive action from the voltage induced in imperfectly compensated armature coils undergoing commutation; third, they must act as a bearing material, preferably without any applied lubrication, maintaining contact with the commutator at surface speeds which may be as high as 70 miles per hour.

It is difficult to obtain, in one material, the ideal properties for each of these divergent functions. It is therefore necessary to seek that combination of properties which will give optimum performance in all respects. Obviously, the combination that is entirely satisfactory under one set of conditions may prove less satisfactory when conditions are changed.

Individual opinions may differ in respect to what constitutes satisfactory brush operation. However, the following can be considered essential elements of completely satisfactory operation and their attainment, in the fullest possible degree, should be sought.

1. Freedom from injurious sparking.
2. Negligible commutator wear.
3. Uniform gloss over commutator surface.
4. Minimum electrical and mechanical losses.
5. Quietness of operation.
6. Good brush life.

Sparking may result from a variety of causes. Failure to complete reversal of current in the armature coil undergoing commutation, while short-circuited by the brush, is one source of sparking. Over-reversal of current is another. Too rapid change of current in the short-circuited coil, interruption of contact between brush and commutator, disintegration of brush faces, breakdown of commutator surface film, formation of high-resistance glaze on commutator surface, and selective action—that is, unequal division of current among the several brushes—are a few of the sources of sparking which may be encountered at one time or another.

Commutator wear may result from the presence of abrasive particles in the brush. Burning of the commutator surface, due to faulty operation, may also be the source of considerable wear. Likewise, the reduction in commutator life resulting from the necessity for frequent resurfacing should be classed as commutator wear. With satisfactory brush operation, commutator wear should not be an appreciable item of machine depreciation.

The nature of the commutator surface has a pronounced influence on brush operation, as will be pointed out later in this discussion. Satisfactory operation requires that a smooth surface of uniform character be maintained. Change in character of commutator surface is almost certain to result in noticeable effect on brush performance.

Energy losses from short-circuited

current in the armature coils during commutation, from the resistance of a glazed commutator surface to the passage of load current, from the unbalancing effects of selective action, and from the friction of the brushes may at times be enough to seriously affect the efficiency or the satisfactory performance of a motor or generator. However, with proper brush selection and operation, these losses can be kept to a small value.

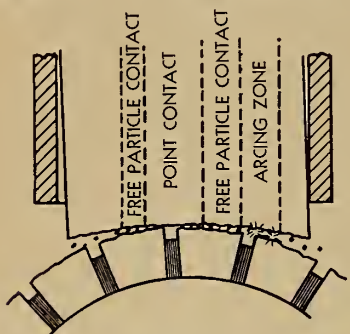


FIGURE 1
Exaggerated drawing illustrating nature of contact between brush and commutator

Quietness of operation is dependent, primarily, on the maintenance of uninterrupted contact between brushes and commutator. Even where freedom from noise is not an essential characteristic of performance, the firm contact on which quiet operation depends has an important influence on satisfactory performace in other respects.

Brush life should not be made a primary objective in brush application. If the other elements of satisfactory brush operation are attained, reasonable brush life may well be expected; but long brush life obtained at the sacrifice of performance in some other respect may prove far from economical.

● Nature of Brush Contact

Before undertaking a discussion of the numerous mutually dependent factors on which the attainment of satisfactory brush operation depends, it would be well to consider the nature of the contact between a brush and the commutator.

It should be realized that the commutator and the brush, however highly polished they may be, do not necessarily present to each other perfectly smooth surfaces of identical curvature. Due to the play of the brush in its holder, and the yielding of supporting members under stress, the brush face may have a slightly longer radius of curvature than the commutator. In such case the actual area of solid contact, for a particular brush at a given instant is probably confined to a relatively short span of the brush face in the direction of rotation.

Furthermore, there are indications that within this area actual contact between brush and commutator is limited to a number of points carrying current at an extremely high current density. Movement of the commutator under the brush face, mechanical abrasion and the destructive effects of the high local current densities cause constant shifting of these points of contact so that solid contact on any single point of either commutator or brush face is probably of extremely short duration, except for firmly imbedded points which protrude to a substantial degree beyond the surrounding surface.

There are three types of paths through which the current flows between commutator and brush: the points of solid contact, mentioned previously; adjacent areas in which free particles of carbon, graphite, copper or other electrically conducting dust provide a conducting path; and open gap, across which some current may pass in the form of an arc. Fig. 1 illustrates, in exaggerated form, this conception of brush to commutator contact.

The assumption that actual contact between brush and commuator is limited, for a given instant, to only a small portion of the brush thickness does not justify the further assumption that commutation must be effected while the mica gap between two commutator segments is traveling that short distance. Not only do the actual points of contact shift rapidly, but the same is true of the area within which those points lie.

It is quite possible for contact to occur at points scattered over essentially the full area of the brush face during a single commutation interval. Therefore, the fact that a brush shows uniform polish over the entire face does not preclude the possibility of contact at any given instant having been limited to a relatively small portion of the total face area.

When there are several brushes of like polarity, connected in multiple, one seems fully justified in considering the cycle of commutation to occupy the full time required for the mica gap to traverse the brush face from leading to trailing edge. There may be instances in which the movement of the area of contact during a single commutation interval fails to cover the full brush thickness and completion of commutation is forced to take place within a very short arc of rotation. However, with normal performance and good brush and commutator surfaces, it seems probable that such cases are the exception rather than the rule.

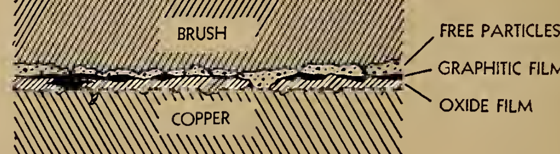


FIGURE 2
Commutator surface film greatly magnified

There appears to be no necessity, as has at times been suggested, of abandoning the classical concept that the normal period of short-circuit for a coil undergoing commutation extends from the leading edge to the trailing edge of the brush.

Inasmuch as firm contact between brushes and commutator is essential to satisfactory brush performance, protruding mica cannot be tolerated. Fortunately, the practice of undercutting the mica below the surface of the copper segments has become general. If this operation is carefully performed, and no fins of mica are left at the sides of the slots, brush application is made substantially simpler.

In the following discussion it is assumed that the mica has been properly under-cut and no reference is made to complications which would certainly result were protruding mica present. It is further assumed that the commutator has been finished to a smooth surface of essentially true cylindrical form, free from high or low spots of appreciable eccentricity or area.

● Commutator Surface Film

One of the most important factors affecting brush performance is the surface film on the commutator. The exact nature of the surface film varies greatly th operating and atmospheric conditions, and there is evidence that the presence or absence of copper oxides in this commutator film may greatly influence performance. Graphite is also frequently found to be a constituent of the surface film. In some cases this may be rubbed into the irregularities of the commutator surface by the wiping action of the brush. In other cases, there are indications that the graphite is transferred from brush to copper by electrolytic action.

The brush face and commutator surface, in highly magnified form, may be considered as resembling the sectional drawing in Fig. 2. No matter how carefully prepared, or how highly they may be polished, a powerful microscope will disclose minor irregularities in brush and commutator surfaces.

A raw copper surface on the commutator does not lend itself to good brush performance. Some oxidation of

the surface appears to be advantageous, improving commutation and reducing friction. It is hard to say just how far oxidation can be carried before encountering disturbing effects. Certainly it must stop short of actual burning, resulting in etching or pitting of the surface of the copper segments.

The development of an oxide surface film in service may require a period of several days or even weeks, depending on machine and operating conditions and the properties of the brushes themselves. Some electro-graphitic brushes must be operated at a substantial current density to result in the formation of the desired surface film. At low average current density no film is developed by such brushes, and film already present may break down, exposing spots or streaks of raw copper. When this condition develops, copper or copper oxide particles may deposit in the brush faces and threading of the commutator result.

Threading is the term used to describe the development of fine, thread-like grooves in the commutator surface. This type of film breakdown may account for operating difficulties sometimes encountered, under sustained low load conditions, on machines which have previously given good performance when operating at normal load. The development of oxide film is sometimes accelerated by the application of external heat to the commutator.

It is possible that this phenomenon of film breakdown at low average density is associated with the high friction of some electro-graphitic brush grades at low interface temperature and the sharp decrease in friction when the interface temperature rises to a certain critical value. Assuming there to be such a relationship, it still is difficult to say which of these phenomena is "cause" and which "effect." The subject of temperature effect on coefficient of friction has been discussed at length by Dr. S. W. Glass.[1]

The property of forming a graphitic film on the commutator varies with different grades of brushes. Some graphitic deposit on the commutator is desirable. It reduces friction, improves intimacy of contact between brush and commutator, and probably helps maintain the interface resistance at the value necessary for good commutation. It is not essential, however, that the amount of graphite deposited on the commutator by the brush be large.

Some brushes have a polishing or film removing effect on the commutator surface. Such property is sometimes highly beneficial to brush performance. It can be imparted to a brush in sufficient degree to prevent the development of a high-resistance film from oil vapor or other atmospheric contamination, and even to overcome a mild tendency toward edge burning and bar marking from over-oxidation, yet without producing sufficient abrasive effect to result in noticeable commutator wear.

The choice between a film forming and a polishing, or film removing, grade is often a matter of operating and local conditions. The same type of machine which requires a film forming brush when operated at light average load in a clean, dry atmosphere may require a polishing grade when operated at full load in the presence of oil vapor. The range and duration of load fluctuations, as well as the average load value, may have an influence on film formation and resulting brush performance.

Disturbing Factors

In the article[1] previously referred to, Dr. Glass mentions a number of materials which have an unfavorable influence on the commutator surface film. The presence or absence of such atmospheric contamination, which Dr. Glass terms "contact poisons," may be the deciding factor in determining the type of brush which will give best performance.

Materials having a deoxidizing effect disturb brush friction and commutation by breaking down the oxide film on the commutator. The presence of chlorine in the atmosphere is very disturbing to brush performance due to its unfavorable influence on the commutator surface film. Sulphur tends to develop a dark, glossy surface on the commutator but its effect on performance is generally detrimental. The unsatisfactory performance encountered in the presence of a sulphide or oil film probably results from excessively high contact drop.

Hellmund and Ludwig[2] have shown that sparking underneath the brush face is liable to occur when the voltage drop across the contact path appreciably exceeds 3 volts. Therefore, while a drop of approximately 1 volt may be needed to properly control the voltage in the armature coil short-circuited by the brush, too high a drop may itself be a cause of trouble.

The same authors point out that a very rapid change of current during commutation results in much higher contact drop than that observed when commutation is effected more gradually. Faulty interpole adjustment, contact over less than the full width of commutator segments, use of brushes that are too thin, or any other condition tending to shorten the commutation interval and compel over-rapid change of current in the commutating coil may produce destructive sparking under the brush face

(Continued on page 23)

[1] "The Measurement of the Frictional Characteristics of Brushes"—Dr. S. W. Glass—*Modern Pyramids, No. 2.*

[2] 'Sparking Under Brushes of Commutator Machines"—R. E. Hellmund and L. R. Ludwig—*Electrical Engineering,* March, 1935.

Try These Canadian Examination Questions

PROJECTIONISTS generally have manifested keen interest in the examinations offered periodically by the Province of Ontario, Canada, as a requirement for projectionist licenses of the first, second and third classes. Therefore, I. P. has decided to publish each month a group of questions culled from these examinations, the answers to each group being presented in the following issue.

Generally regarded as constituting the most difficult examinations offered anywhere, these questions should prove particularly helpful to the younger craftsmen and at the same time provide the so-called old-timers with an opportunity to brush up on their knowledge of the trade which they have pursued for so many years. Examinations for first-class licenses comprise 24 questions which must be answered within three and one-half hours, and are divided into five sections relating to Projection and Film, Electrical, Mechanism, General and Safety, and Sound.

No written answers to I. P. are solicited, and each participant can keep his own score on the basis of 100% as a maximum and 80% as a minimum passing grade, with the value allotted being indicated alongside each question.

The first group of questions from the examination for licenses of the first class are appended hereto:

1. (a) Name and describe in detail three types of condenser lenses, and explain how to find the focal length of each. (Value 3.)

(b) Find the equivalent focus of a 7.5-inch bi-convex and a 7.5-inch meniscus lens. (3.)

(c) Has an elliptical mirror any chromatic aberration? Tell your reasons for your answer. (3.)

2. Describe fully three types of projection screens and state which in your opinion gives the best results. (3.)

3. Why does the objective lens of a projector consist of two bi-convex, a plano-concave and a meniscus lens of different kinds of glass? (2.)

4. Using a standard release print:

(a) Why is the motor-start distance to the changeover 12 feet and 6 frames? (2.)

(b) Tell how to find out the exact motor pick-up speed. (2.)

5. (a) Name and describe the various kinds of 35 mm. film that are in use. (1.)

(b) Where can the various types of film be used? (1.)

Some Television Problems From the Motion Picture Standpoint†

By *G. L. BEERS, E. W. ENGSTROM* and *I. G. MALOFF*
RCA MANUFACTURING CO., INC.

THE prime objective of television, in common with other pictorial arts, is to create an illusion. There are certain limitations on how good the illusion can be: some inherent and others dependent on the state of the art. Many of these limitations have a counterpart in motion pictures, and it is the purpose of this paper to review and compare some of these mutual restrictions.

Picture detail in motion pictures is ultimately determined by the optical system and the resolution of the film. The factors determining picture detail in television are more complex. The frequency-band width limitations imposed by a single-channel communication system suitable for television broadcasting makes it necessary to divide the scene arbitrarily into elemental areas and transmit the information representative of light and shade, area by area and line by line until the entire scene has been scanned.

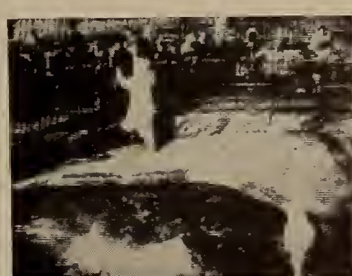
With such a television system the basic factors determining picture detail are the number of scanning lines, the size of the scanning spot, the frequency-band width, and the optical system. In practice the first two factors are definitely related, since the size of the scanning spot is commensurate with the distance between centers of scanning lines.

†J. Soc. Mot. Pict. Eng., XXXII (Feb. 1939).

Television will undoubtedly utilize motion picture film to a great extent for the transmission of programs. Some of the problems incident to scanning the film image, including those relating to the use of an intermittent projector mechanism, are detailed in the appended condensation of this extremely interesting paper.

In the television standards of the Radio Manufacturers Assoc. (R.M.A.) scanning is expressed in terms of the total number of lines from top to bottom from the beginning of one frame to the beginning of the next frame. Since in a practical television system both spot size and frequency-band width are chosen on the basis of the number of scanning lines, the inherent resolution of a television system may be expressed as the number of scanning lines per frame. Fig. 1 is made up of four repetitions of the same subject with detail equivalent to 60, 120, 180, and 240 scanning lines.

60 SCANNING LINES



120 SCANNING LINES

180 SCANNING LINES

240 SCANNING LINES

FIGURE 1 *Pictures depicting characteristics representative of television images for several numbers of scanning lines*

Another means for evaluating the resolution of a television system is to estimate its ability to tell a desired story in comparison with 16 mm. home movie film and equipment. The result of such a comparison by a number of observers is that a 400- to 500-line television system compares favorably with 16 mm. home movies in permitting observers to understand and follow the action and story. The scanning standard adopted by the R.M.A. is 441 scanning lines per frame.

● Frame Frequency, Flicker

Television images consist of rapidly superimposed individual frames much the same as in motion pictures. In the case of motion pictures a group of time-related stills is projected at a uniform rate, rapid enough to form a continuous picture through persistence of vision. By present methods, each frame of a television image is built up element by element in some definite order and these time-related frames are reproduced at a rapid rate.

In motion pictures the frame frequency determines how well the system will reproduce objects in motion. This has been standardized at 24 frames per second. In television other factors than the ability to reproduce motion have made it necessary to use a frame frequency of 30 per second.

Motion picture projectors commonly used are of the intermittent type. The usual cycle of such a projector is that at the end of each projection period the projection light is cut off by a shutter, the film is then moved a step so that the succeeding frame registers with the picture aperture, and the shutter then opens, starting the next projection period. This is repeated 24 times per second.

Since projection at 24 light-pulses per second with the screen brightness levels used in motion pictures causes too great a flicker effect, the light is cut off also at the middle of the projection period for each frame for a time equivalent to the period that it

is cut off while the film is moved from one frame to the next. This results in projection at 24 frames per second, with 48 equal and equally spaced light-pulses. Such an arrangement provides satisfactory results from the flicker standpoint.

In television, because of the manner in which the image is reconstructed, a continuous scanning process, it is not practicable to break up each light pulse further by means of a shutter in a manner similar to that used in the projection of motion pictures. We therefore have in an elementary television system a flicker frequency corresponding with the actual frame frequency. This is satisfactory at very low levels of screen brightness, but becomes increasingly objectionable as the screen brightness is raised.

In motion pictures the projector shutter opening in terms of degrees for each frame has an important effect on the flicker characteristics. Cathode-ray tubes—Kinescopes—are at present the preferred means for television image reproduction. In the Kinescope each element of the image on the luminescent screen, when excited by the electron beam, fluoresces and assumes a value of brightness corresponding with the value of the electron-beam strength. Upon removing the excitation this brightness then decays (phosphoresces) in an exponential manner and at a rate dependent upon the screen material.

The phosphorescence or persistence of the image screen aids the persistence of vision of the eye in viewing the reproduced image. However, as previously stated, far too much flicker is present at 24 or 30 frames per second for the desired levels of screen brightness.

● Method of Scanning

A particular method of scanning is therefore used to modify the overall image flicker. This is possible because scanning is a continuous process. Scanning may be in equal horizontal strips or lines from top to bottom in numerical order of lines 1, 2, 3, 4, ... (progressive scanning). This results in one overall light-pulse for each frame. If the procedure is modified so that scanning is for the first half of one frame period in the order of lines 1, 3, 5, 7, 9, ..., from top to bottom of the frame, and for the second half of the frame period in the order of lines, 2, 4, 6, 8, 10, ..., from top to bottom of the frame (interlaced scanning), then the flicker effect of the reproduced image is changed. This method of scanning is shown diagramatically in Fig. 2.

Each frame now consists of two portions (two *fields*) with respect to time: each field composed of a group of alternate lines, and the two sets of alternate lines are properly staggered to form a complete interlaced pattern. In progressive scanning each line flickers once per frame, and neighboring lines differ in time relation only by the time required for scanning one line. There is, therefore, no noticeable inter-line effect. In interlaced scanning also each line flickers one per frame, but neighboring lines differ in time relation by one-half a frame period. This results in two flicker effects—an overall effect and an inter-line effect.

As previously stated, a frame frequency of 30 per second with progressive scanning produces an intolerable flicker. A frame frequency of 60 per second is certainly satisfactory from the flicker standpoint, but the frequency-band width required for transmission is doubled. With interlaced scanning at 30 frames, the overall flicker effect is the same as with 60 frames progressive scanning, and no increase in frequency-band width is required. Each line flickers at the rate of 30 per second and adjacent lines flicker with respect to each other, since they are scanned with a time-difference of 1/60 of a second. At optimum viewing distances for television images and for practicable levels of screen brightness this inter-line flicker is not noticeable.

A frame-frequency effect peculiar to television is encountered in the operation of cathode-ray television receivers from an alternating-current power-supply system. The effects of ripple voltages and fields appear in the reproduced image in a variety of forms and from numerous sources. If the frame-frequency differs from the power-supply frequency, that is, differs except in terms of integral multiples or sub-multiples, then these effects move across the image at rates dependent upon the time-difference between the frame-frequency (multiple) and the power-supply frequency. This moving ripple pattern is almost as disturbing as flicker and the visual effects are about the same.

Also, for interlaced scanning these ripple effects cause moving displacements in the position of alternate sets of lines and tend to destroy the interlaced pattern. If the frame-frequency has an integral ratio to the power-supply frequency, 30 frames for a 60-cycle source, then the effects are stationary on the image and very much less pronounced, thus making it possible to obtain satisfactory performance when using comparatively inexpensive apparatus.

On the basis of these factors the R.M.A. has standardized interlaced scanning with a frame-frequency of 30 per second and a field-frequency of 60 per second.

● Film Projection Process

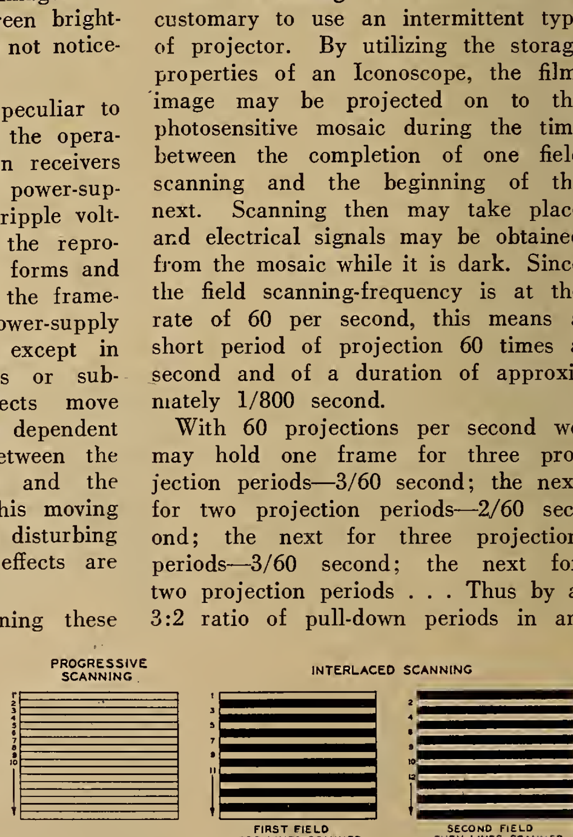
Motion picture film is one source of program material for television. With electronic scanning methods it is usual to project an image of the film moving or stationary on to some element of the electronic translating device. This may be accomplished by the use of an intermittent type of projector, a continuous projector having an optical intermittent, or a system in which the film moves continuously with a compensating motion of film-image and scanning. The particular method used is partly determined by the type of electronic scanning device. The use of 24-frame motion picture film to produce 30-frame television with interlaced scanning presents certain special problems.

In using an Iconoscope as the electronic translating device it has been customary to use an intermittent type of projector. By utilizing the storage properties of an Iconoscope, the film-image may be projected on to the photosensitive mosaic during the time between the completion of one field scanning and the beginning of the next. Scanning then may take place and electrical signals may be obtained from the mosaic while it is dark. Since the field scanning-frequency is at the rate of 60 per second, this means a short period of projection 60 times a second and of a duration of approximately 1/800 second.

With 60 projections per second we may hold one frame for three projection periods—3/60 second; the next for two projection periods—2/60 second; the next for three projection periods—3/60 second; the next for two projection periods . . . Thus by a 3:2 ratio of pull-down periods in an intermittent and by the use of a shutter that is open only during the vertical return of the scanning, we may derive program material for a 30-frame television system from standard 24-frame

FIGURE 2

Diagrammatic illustration of progressive scanning and interlaced scanning



sound motion picture film, retaining the standard film speed. This 3:2 ratio of pull-down periods is shown in Fig. 3.

In picture-detail capabilities a 441-line television system compares favorably with 16-mm. home movies. If motion picture film is used to provide television program material, satisfactory results may be expected from 35-mm. film; a slight loss in picture-detail will result from the use of 16-mm. film, and the resolution capabilities of a high-definition television system will not be utilized if 8-mm. film is used.

In motion picture work studio lighting and make-up technic are dependent upon the color-response characteristics of the film. In television the spectral response characteristic of the Iconoscope controls these factors. The Iconoscope gives maximum sensitivity in the blue end of the spectrum. The most desirable Iconoscope spectral characteristic for a given application is dependent upon the light-source used to illuminate the scene. An Iconoscope tends to compensate for the high red output of the incandescent lamps used in studio lighting.

● Kinescope Characteristics

For outdoor pick-up work a characteristic more nearly approximating that of panchromatic film is desired. The spectral characteristic of the Iconoscope can be varied to a considerable extent by the sensitization procedure employed. Various spectral-response characteristics obtained in experimental Iconoscopes have indicated that characteristics can be provided that are comparable to those of panchromatic and other films.

The high-intensity arc commonly used as a light-source for motion picture projectors produces an image that has satisfactory black-and-white characteristics. In the initial stages of cathode-ray television development so many serious limitations were present that the green color of the image reproduced on a willemite screen was not considered to be particularly undesirable. As television development progressed and picture-detail and screen brightness improved, the green color of the reproduced image became more objectionable, and development work on luminescent materials to produce a black-and-white image was started.

FIGURE 4

Two special television film projectors

Kinescopes having luminescent screens giving black-and-white pictures of adequate brilliance are now a commercial reality. Individual opinions vary greatly as to which is the best white for television screens, since the apparent whiteness of a television image is influenced by such factors as the image brightness and the background lighting in the room in which the image is viewed. One thing is certain, and that is that purchasers of television receivers will demand substantially black-and-white images.

Although the brightness range in television images may be limited in several portions of the system, the present practicable limit is in the Kinescope. The bulb shape of the Kinescope is determined by the physical characteristics necessary to withstand atmospheric pressure. For this reason the screen of a conventional Kinescope has a certain curvature, thus permitting illuminated parts to throw light directly on non-illuminated parts. Reflections may occur also from other portions of the inner surface of the bulb.

In addition to these reflections, a certain amount of light is totally reflected from the glass-air boundary and introduces a reduction of range in details by halation. These effects have been reduced by blackening the inside walls of the bulb and by introducing a small amount of light-absorbing material in the glass wall. Conventional Kinescopes have an available range of

(Continued on page 24)

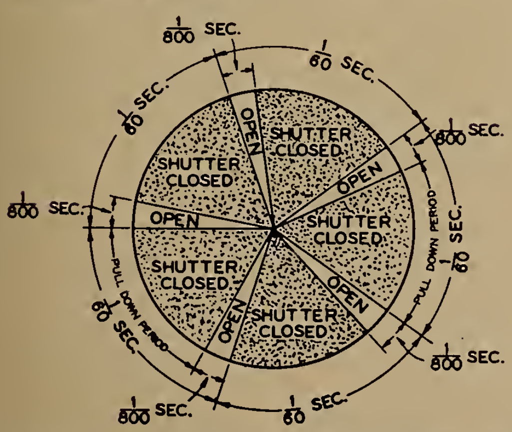


DIAGRAM OF ONE COMPLETE CYCLE OF OPERATION OF TELEVISION FILM PROJECTOR
ENTIRE CIRCLE IS $\frac{1}{12}$ SECOND

FIGURE 3

Diagram illustrating the 3:2 ratio of pull-down periods in a special television film projector

BRITISH THEATRICAL TELEVISION

Theatrical television was introduced in London, England, with the BBC telecasting programs recently to the Tatler Theatre and the Marble Arch Pavilion. Both theatres are fully equipped with the most advanced Baird projectors and will throw the televised programs on a screen 15 by 12 feet.

Meanwhile, official BBC figures for 1938 disclose that over 18 per cent of the total program time occupied by television was devoted to pix. This represents 172 hours out of a 957 total.

RADIO-FILM WAR CONTINUES

Despite the withdrawal of several 20th Century-Fox stars from radio engagements and rapidly mounting protests from exhibitor organizations against radio competition, the major film companies indicated that they will make no move to follow the lead of 20th but, on the contrary, encourage radio appearances by their players. Radio executives continue to hold that the airwaves do not seriously affect the box office take on "good" pictures, but in fact help it. To all of which exhibitors vote an emphatic "No!"

Just a penny postcard bearing your old and new addresses is needed to insure regular receipt of I. P. You'll like this, and we'll appreciate it. Thanks.

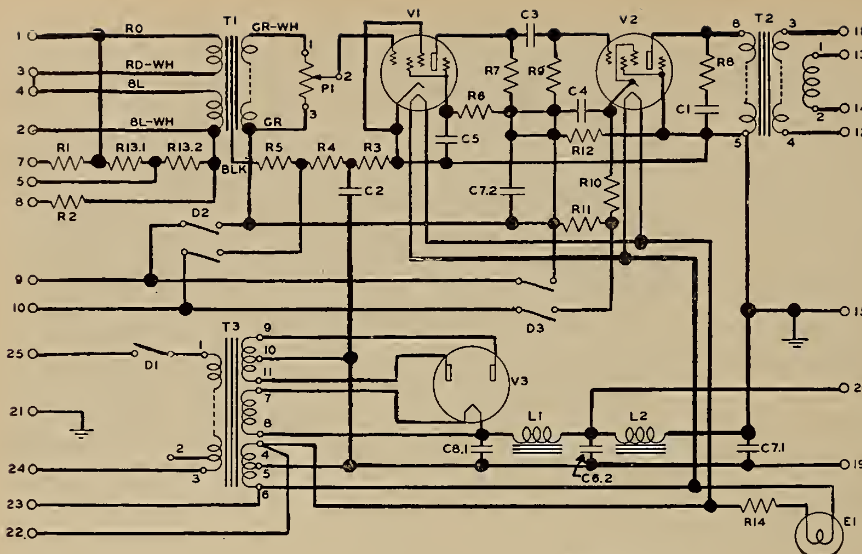


FIGURE 2

Fifth Subscription Contest Diagram; Many Winners on Broadcast Circuit

OUR tart remarks last month about the poor showing made by the craft on these Contest diagrams were sent winging back into our bridgework when no less than 28 contestants popped up with the right answers—the highest number of winning entries since the Contest was launched. Of course, we wish we could ascribe this fine showing to a wider participation in the Contest or to our editorial prodding, but, alas, we fear that the reason therefor lies in the great similarity in successive diagrams and in the changes made.

The current Contest offering (Fig. 1) should prove considerably more difficult because it applies to an equipment that is about five years old, is little used in the theatre field, and demands that the contestant know his circuits. Some new wrinkles in the way of elisions and additions have been introduced, but these shouldn't impose undue strain on competent craftsmen. Naturally, practically the entire circuit has been redrawn, thus it is useless to seize upon faulty tracing as a clue to the changes made.

In toughening up this month's entry I. P. is merely following the suggestion of a majority of contestants. Expressions of opinion as to the desirability of tracing these diagrams out in detail, instead of merely citing the changes made therein, are solicited.

In line with established custom, only subscribers to I. P. are eligible to compete in this Contest. All answers must reach I. P. not later than March 21. It is not necessary to enclose a copy of the diagram; merely list the corrections. Each successful contestant will receive a one year's free subscription to I. P. How many would prefer that the award be $1 instead of a subscription?

A couple contestants failed to score this month for what were obviously errors in transcribing their answers. All answers should be checked carefully before mailing to provide against such errors—such as substituting "R2" for "R12", and the like.

Last month's circuit was another W. E. voice amplifier used for broadcast work (Fig. 2). The errors therein were:

1. Dot removed from the crossing at the left of R5.
2. Dot removed from the first crossing below C2.
3. Dot added to the crossing at the bottom of C1.
4. Dot added to the crossing at the left of R12.
5. Jumper added between R6 and C4.
6. Jumper added from terminal 15 to the first line to the left.

● 28 Winners on Last Circuit

The winners on this diagram were: Walter Fink, Mahanoy City, Penna.; Lloyd Frazier, Boone, Iowa; M. J. Haskin, Detroit, Mich.; Fred Snodgrass, New Martinsville, W. Va.; Ralph W. Rushworth, Baltimore, Md.; Calvin E.

(*Foot of Col. 1, next page*)

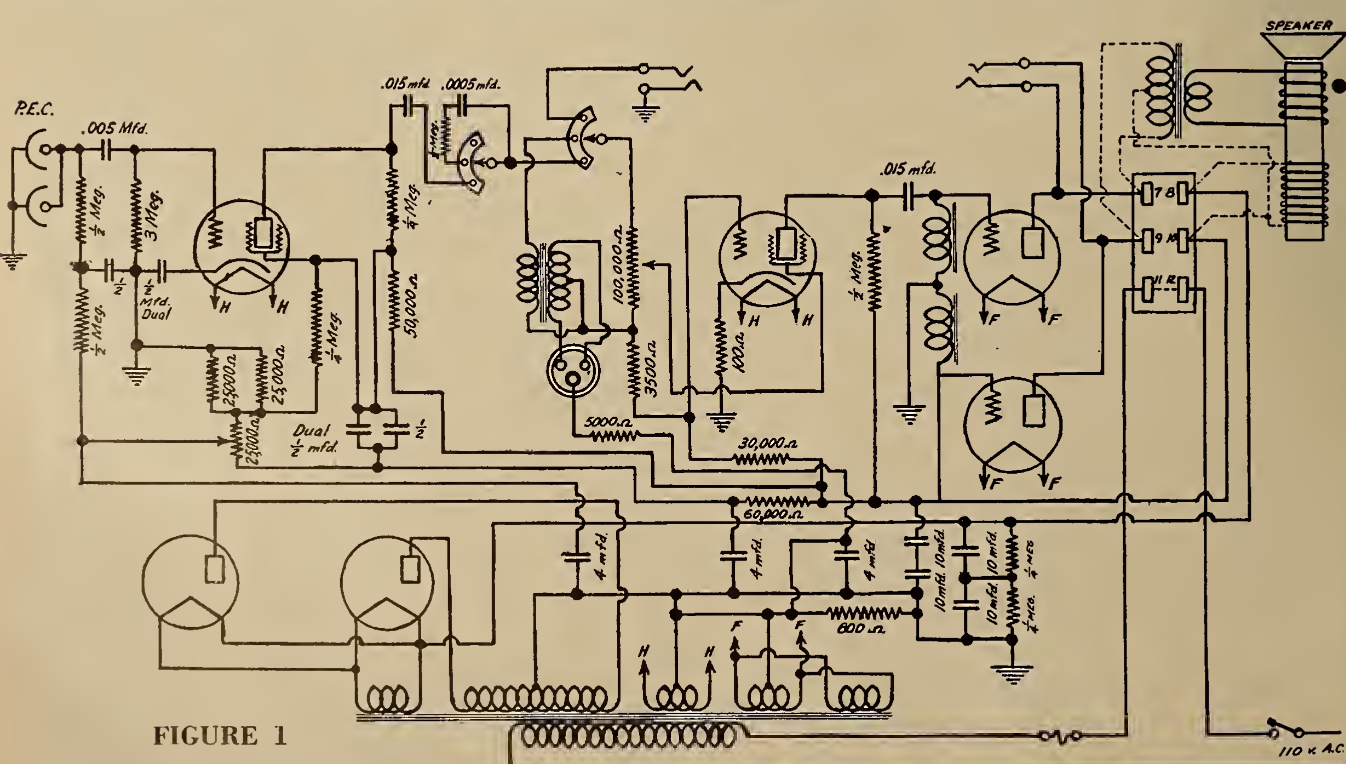


FIGURE 1

The Language of Lighting

COLOR is a pleasing visual experience which nature has used extensively to give variety and beauty to the landscape and the sky overhead. The brilliance of the flowers, the green of the trees, the radiance of the sunset, and the multicolors in the rainbow, all present a kaleidoscope to stimulate interest in color and to excite human ingenuity to duplicate it artificially, that this visual experience may be brought under man's control and applied wherever desired, day or night, independent of nature. To achieve this, in so far as it is possible to do so with light, one must, of course, know something of the theory of color.

It is necessary, first of all, to become familiar with some of the fundamentals of color terminology. A color is characterized by three qualities—*hue*, *brilliance* and *saturation*.

● Color Terminology

Hue. It has already been shown that hue, the fundamental quality of all colors, is determined by the frequency of the ether vibrations; thus hue is determined by the position in the spectrum and is identified as red, blue, *etc.*

Brilliance. A color of a certain hue may be dark or light. This has nothing to do with the frequency of the ether vibrations, but depends on the amount of light reaching the retina of the eye in a given time. This characteristic of a color which causes it to appear as dark or light is known as its *brilliance*, *luminosity* or *brightness*.

II. COLOR

Saturation. If to a color of one wave-length—red, for example—white light consisting of all visible wave-lengths is gradually added, the red becomes paler and paler. In its original condition, this red is regarded as a pure color and is said to be perfectly saturated. It becomes less and less saturated as the white light is added.

Almost all colors seen in ordinary life are due to selective reflection of white light, and since some portion of all the wave-lengths is reflected, these colors are usually far from saturated. When a leaf is seen by sunlight, for example, it appears green because the leaf reflects the green wave-lengths more efficiently than any of the others. However, it does not completely absorb all other wave-lengths; nor does it reflect all the green.

It should be emphasized at this time that a color is by no means a simple elementary phenomenon, but a complex psychological state, depending not only on whether the stimulating ether vibrations are long or short, or the level of the light high or low, but on many other factors as well. Among these might be mentioned the condition of the retina with respect to its previous stimulation (state of adapation); the stimulation taking place in neighboring portions of the retina (contrast); the part of the retina being affected by the light, and the duration of the stimulus.

These factors combine to give rise to an almost endless variety of colors, equalled only by the variety of names which fashion experts, and others, find to attach to them. It is instructive to observe that, in spite of all these complications, visual sensations are of such a nature that all colors, including white, can be produced by combining three properly selected primary colors according to certain laws of color mixing.

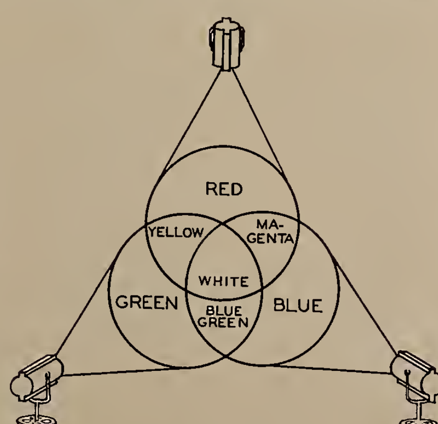


FIGURE 1
Color mixture by addition of wave-lengths of light

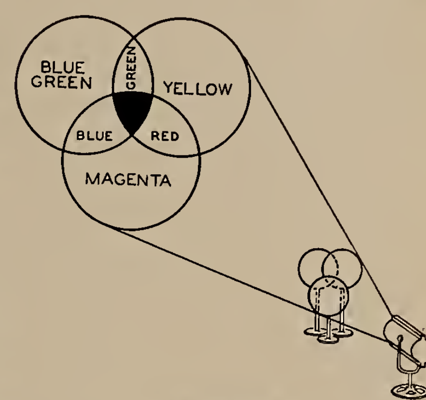


FIGURE 2
Color mixture by subtraction of wave-lengths of light

● Color Mixing Methods

There are two methods of color mixing, the *additive* and *subtractive*. If on a screen a blue beam and a separate yellow beam of light are projected, the portion where they overlap will be white. These colors are, therefore, said to be complementary, and this method of combining colored beams is called the *additive* method of color mixing. The tendency in this method is always to produce more light and to approach white. The primary colors for the additive method are red, green, and blue. Red and green combine to give yellow and all the intermediate shades; red and blue give magenta, and green and blue give a blue-green. This method of color-mixing is illustrated in Fig. 1.

If a beam of white light is made to pass through a piece of yellow glass and a piece of blue-green glass placed behind one another, the light passing through will be seen as green. This is called *subtractive* color mixing and the tendency in such cases is to obtain less light and to approach black. The three primaries for subtractive mixture are the exact complements of those for the additive method. These are blue-green, magenta, and yellow (Fig. 2). They are approximately the blue, red, and yellow which are used in painting. Colored pigments, when mixed, behave accord-

(*Continued on page 21*)

WINNERS ON CONTEST DIAGRAM

Mervine, Pottsville, Penna.; Victor Schulman, Brooklyn, N. Y.; George W. Finch, Cuyahoga Falls, Ohio; James A. Day, Detroit, Mich.

Also, Lewis M. Edwards, Trenton, N. J.; Lewis H. Sigworth, Erie, Penna.; Stanley Henry, Beaver City, Nebr.; Walter W. Wehr, Allentown, Penna.; C. H. Perry, Sudbury, Canada; Vernon J. Malstron, Salt Lake City, Utah; Ray Mowery, Mahanoy City, Penna.; Chester A. Ellison, Reading, Mass.; Francis L. Hill, St. Petersburg, Fla.; Hugo Bryant, Conway, Ark.

Also, Geo. Wilde, Columbia, Ill.; George H. Smith, Weiser, Idaho; James C. Walker, Phillipsburg, N. J.; Howard B. Smith, Springfield, Mass.; Kenneth McLay, Milwaukee, Wis.; Raymond A. Wood, Poughkeepsie, N. Y.; Joseph J. Korzak, Grand Rapids, Mich.; J. J. Edgerly, Fall River, Mass.; and Ralph M. Hinshaw, Weiser, Idaho.

Projectionist + Serviceman = A Star Show Business Team

Altec Service Corp. Files Reveal how Cooperative Effort Keeps the Show Going

By *LEROY CHADBOURNE*

OFTEN as I watched the sound system serviceman busy himself in my projection room I have been struck by the thought that here indeed was a novel form of teamwork—between projectionist and serviceman—concerning which there had been very little of interest said or written. And, more important, such teamwork was not dedicated to the glory of dear old Siwash but rather to the very practical proposition of helping mightily in keeping a great industry going.

The more I speculated on this teamwork within the confines of a projection room, without benefit of applauding crowds or blaring bands, the more convinced I became that here was a story clamoring to be told.

So one day I hied myself over to the offices of Altec Service Corp., cornered some of the boys and persuaded them to dig out of their files some typical instances—"real life stories," you might term them—of how the team of projectionist plus serviceman could lick a problem in the heartiest kind of cooperation, when neither of them could lick it alone half as easily. In other words, it was "teamplays" I was looking for; and here are the stories—out of dozens of such experiences—the Altec men dug up for me:

● Fast-Thinking Projectionist

The Altec inspector received an emergency call from the Jefferson Theatre, Newport News, Va. The theatre advised that the stage speakers had failed, and would the Altec men come at once? When the latter arrived, he found the stage speakers completely out—and was astounded to find that the show was still going on to the satisfaction of a good-natured audience, all as a result of some fast thinking on the part of the projectionist.

When the sound from the stage speakers failed, and while the serviceman was enroute, the projectionist didn't sit back and twiddle his thumbs. Instead, he moved the monitor horn from its usual location and placed it at a room porthole into the auditorium. He was delivering sound to the audience—not from the stage but from the back of the house! Unorthodox procedure though that was, it kept the show going—and prevented refunds.

This was the first time that Altec's monthly trouble call analyses ever recorded this ingenious method by which a projectionist who was "on his toes" literally *forced* the show over.

Whether engineering training or plain hard experience is the more important asset in sound system trouble-shooting is one of those arguments for the long winter evenings. Engineering training provides a background which allows the trouble shooter to think out the relation between trouble-*cause* and trouble-*effect*. That method often takes time. Experience, on the other hand, gives the trouble-shooter that uncanny ability to "put the finger", almost by instinct on the parts which are causing the trouble. Call it a "sixth sense" if you like, but that kind of experience can be gained only after a man has handled literally hundreds of emergency calls.

● Hot and Cold Speakers

The ideal combination, however, is engineering *plus* experience—and here's a case in point.

The Palace Theatre, Minneapolis, turned in an emergency call for the Altec inspector, reporting that the meter on the KS-6540 horn current control cabinet was reading 1.9 amperes instead of the normal 3 amperes. There was no other evidence of trouble, the sound reproduction apparently continuing as normal.

Victor Welman of Cleveland L. U. 160 caught by a sneak-shot as he prepares to startle the scientific world with his contribution to the last SMPE convention papers program

(One Sperber, alleged photographer, also sneaked the shot into this slot.)

However, the projectionist had his eyes open, and when he noticed that a meter was reading abnormally low, he rightly took this as a danger signal and called the serviceman.

Upon his arrival, the Altec man immediately went backstage to check the speakers, because he knew that the control cabinet furnished the current for operating the speaker fields. Then, instead of staging a big act by taking out an assortment of meters to make things look "scientific", he just walked up to each of the No. 555 receivers, the speakers, and *felt* them with his hand to see whether they were *warm or cold!*

Experience had taught him that normally-operating receivers are slightly warm, as a result of the heat dissipated in the resistance of the field coil. In this case he found that two of the four receivers were cold, and this instantly gave him the clue for the abnormal current reading on the meter of the KS-6540 control cabinet noticed by the projectionist. The sound reproduction had continued because the remaining two receivers were still operating.

Tracing further, the inspector found that the two cold receivers were not operating because of corroded terminals in a horn cable plug. This caused an open circuit which shut off the current to these two units.

● The Villianous Vaudevillian

Over a period of several months, emergency calls came in from various theatres in Texas. The projectionists were mystified, and so were the Altec inspectors when they got to the theatres and found that the former had their equipments in apple pie order. Nothing was wrong—except that the No. 555 receivers suddenly failed to operate.

What's more, every theatre in this group had *exactly the same trouble*, for no assignable reason.

The Altec men and the projectionists donned their combined thinking caps. There was a vaudeville act touring the State. After these mysterious failures

had been piling up on the emergency reports, it developed that the failure of the horns occurred directly following this particular act—*in every theatre affected!*

Very mystifying, all this. Then came the denouement. It developed that during the act in question one of the actors fires a blank pistol shot, and the fellow he was supposed to shoot always stood right in front of the mouth of one of the big horns used behind the screen in the sound system.

The concussion from the pistol shot, directed into the horn mouth, caused the receivers to fail! In each case, either the voice coils were found torn entirely loose from the receiver diaphragms, or the diaphragms themselves were punctured. The sound entering the large horn mouth was carried through the narrowing sound passage of the horn until it reached the receiver diaphragm tremendously concentrated.

A friendly word of advice to the villian—the vaudevillian, that is—was sufficient to bring a stop to this wave of receiver failures.

● Lights Burned Brightly

Many serious shutdowns resulting from sound system failure are averted by emergency methods which have been devised beforehand for just such occasions. These schemes normally consist of cutting out certain parts of the apparatus which, although contributing materially to the quality of the sound reproduction, can be dispensed with in an emergency.

For example, cutting out the final power amplifier of the system, and operating at the reduced power output of the preceding amplifier. For example, cutting out the pre-amplifier of one machine and continuing operation by strapping the photo-electric cell from the defective machine over to the pre-amplifier of the remaining good machine. For example, operating the exciter lamps on a. c. or storage batteries in case the d. c. rectifier fails.

In the case of the Grand Theatre, Orlando, Fla., the amplifier failed. The projectionist immediately got on the job and established the fact that the trouble was due to a short-circuited filter condenser. When he determined this, he knew just what to do. He opened a pre-arranged connection which disconnected this particular filter condenser, following which the amplifier was able to continue operation on the remaining filter condensers.

Having gotten the show back on the sheet, the projectionist called the Altec man and told him exactly what had happened. The latter, after the show, isolated and replaced the particular defective condenser which caused the trouble.

Somebody in the theatre reported that all of the lights in the house had burned very brightly for a few minutes on the day preceding the condenser failure. Using this clue, investigation led to the conclusion that the condenser failure had resulted from a violent fluctuation in the power supply to the theatre.

Well, the foregoing citations give you an idea of what good teamwork between projectionist and service inspector can do. There are dozens of cases in the same files from which these came. Want to read more of them?

Newburgh, N. Y., 2-Men Shift Law Wins in High Court

The long-disputed Newburgh, N. Y., ordinance governing the employment of projectionists has been unanimously upheld by the N. Y. State Court of Appeals in a final decision on a case of great importance to the organized craft throughout the country, in view of the prestige of the N. Y. Appeals body. Adopted originally in 1936, the ordinance provides for the employment of two-men shifts at all times while a theatre is operating and for licensing by a local board of examiners.

Theatre owners contended that the ordinance was unconstitutional, that two-men shifts are unnecessary, that the law was passed through "undue influence" (the president of the I. A. Local is also Mayor of Newburgh), and that license renewal is permitted without re-examination. Opposing counsel stressed the safety feature of a full projection crew, denied allegations of irregularity in the passage of the law, and maintained that State law does not prohibit a third-class city (as is Newburgh) from making its own regulations as long as they don't conflict with State law.

The decision being unanimous, no further appeal is likely.

Ask for Safety Crews in W. Va., Iowa; Nebraska Foray

Two-men-shift bills have been introduced in the legislatures of West Virginia and of Iowa. Both the I. A. men and the exhibitors in latter State professed to know nothing anent source of the bill, similar legislation having been defeated twice within past four years. Large chain theatres in Iowa already comply with bill's provisions. The West Virginia bill provides in part:

"While operating such moving picture machines each operator shall devote his entire time to the operation of said machines; he shall not leave the operating side of such while in use, nor engage in any unnecessary conversation with anyone, nor perform any other duties other than the operation of such machines."

The bill also provides a penalty of $25 a day for non-observance of law, with each day constituting a separate offense.

Nebraska projectionists are seeking favorable action on legislation requiring toilet facilities in the projection rooms of all theatres located in towns of 1,000 or more population.

OKLAHOMA LAW IRKS CRAFT

Scores of letters have been received anent the decision of the Oklahoma Supreme Court which classified motion picture projection as a "non-hazardous" occupation under the meeting of that State's compensation law, but I. P. fails to note any concerted action by the craft or any section of it looking toward possible revision of such laws in Oklahoma and elsewhere.

IPC COAST REPRESENTATIVE

Jack Durst is now acting as factory representative on the Coast for International Projector Corp. Active in the sound picture field since 1928 and identified with the development of the Simplex sound system, Durst will contact the Academy and other groups in carrying through to reproducing equipment design the latest production refinements.

The new streamlined RCA Photophone projector soundhead

The Zeiss Ikon Stereoscopic Process

PREPARED BY THE TECHNICAL BUREAU, ZEISS IKON, AG., DRESDEN, GERMANY

The accompanying article details the latest development in Europe in the unceasing quest for commercially practicable three-dimensional motion pictures. This Zeiss Ikon process reveals nothing startling new, (including the use of polarized light) other than the methods of taking and showing the pictures, which procedures require special attachments for both camera and projector.

TECHNICAL efforts no less than artistic considerations continually revive the question as to the possibilities of perfecting the film picture of the present day. Action, speech, music, and even color are embodied in the film. There is only only thing which it lacks, and that is the visual impression of three-dimensional solidity in space.

In the motion picture we see photographs, in which the impression of a certain degree of substantiality in space is simulated through skillful gradation in the lighting effects, but the impression of true material substance as presented by all bodies as we see them in Nature is still wholly absent in the modern film. Nevertheless, the production of pictures conveying the impression of solidity in space is an old established achievement in the form of stereoscopic pictures.

In the device in which this is accomplished two photographic pictures of an object or a person are taken in the place of the usual single picture. These two pictures are not identical but conform to the two pictures as seen respectively by the right and the left eye. The picture seen with the left eye will show the object in question a little more from the left, and that seen with the right eye a little more from the right.

When these two pictures are viewed jointly in such a way that either eye sees only the picture relating to it, the impressions imparted through the two eyes separately are merged into a single picture by our brain with the result that we see the represented objects in solid relief as we do when viewing them directly. In fact, it is only by the joint effect of the pictures received and interpreted by the two eyes that we receive the natural impression that an object is actually occupying a definite position in space.

● Stereo Film Drawbacks

The reader may remember that before the days of the motion picture film stereoscopic pictures of this kind were frequently shown to the public in the so-called panoramic theatres. Even in our days photographs are extensively taken by amateurs with the aid of stereoscopic cameras and viewed through stereoscopes. The disadvantages of this method is that the picture can only be looked at by only one person at a time.

For years efforts were made, with varying success, to devise a means of showing to a gathering of spectators moving pictures of this kind. We may mention in this connection the green-and-red motion picture shows, in which the two component pictures—one red, the other green—were projected upon a screen. When these pictures were viewed through spectacles containing a green and red glass or filter, either eye would see only the picture appropriate to it.

This method has great drawbacks: first, because the color has a very disturbing effect, and secondly, because many persons do not see colors normally or are even color-blind. Moreover, it is obvious that color films could never be shown stereoscopically by this method.

Recently a process, on the development of which we (Zeiss Ikon) have worked for some considerable time, has been tried out with complete success on a fairly extensive scale. A stereoscopic film shown in the Ufa-Palast am Zoo in Berlin made a sensational impression upon the 2,000 spectators present on that occasion. This system is based upon the use of so-called polarized light. Light, it should be recalled, is an electromagnetic mode of wave-motion in which normally the oscillations occur in all directions at right angles to the line of propagation. By the use of special filters it is practicable to influence these oscillations of light in such a way as to confine them to a single definitely determined plane.

FIGURE 1
A Z. I. stereoscopic film

In the stereoscopic film system developed by us the two component pictures corresponding to the normal distance between the human eyes are taken within the conventional film picture size of the standard film by means of a special optical device forming part of the motion camera. As the subdivision of the film picture into two halves would result in the formation of vertically oblong pictures, the associated pairs of pictures are taken on the film at *right angles to their usual position* (Fig. 1) in order that on the motion picture screen they may be restored to the normal transverse oblong.

● Projector Attachment

In the reproduction on the screen the two component pictures are projected by means of a special optical attachment, which can be appended without trouble to any standard motion picture projector. In the act of projection the pictures are turned through 90° into their original position in the standard film and rendered coincident on the screen. Each of the two beams of rays has a polarizing filter included in its path in such a way as to impart to the two rays a definite form of oscillation differing one from the other. The screen receives accordingly two rays of light which are polarized in different directions.

An essential requirement of this system is that no element should be allowed to intervene which might interfere with the polarizing effect at the points where the rays of light meet the screen. They should accordingly be projected upon a screen which ensures the maintenance of the particular oscillation imparted to the light. Apart from ground glass surfaces, metal surfaces of the nature of silver screens are particularly well adapted for this purpose.

If now the two component images be viewed through spectacles containing likewise two polarizing filters having their planes of polarization appropriately directed with respect to each another, either eye will see only the picture appertaining to it, while the rays of light proceeding from the other picture are extinguished by the filter so far as this eye is concerned. The like,

though reverse, process applies to the other eye. The resulting effect is accordingly that either eye sees only the picture appropriate to it.

To render this more easily intelligible, the entire act of projection is indicated diagrammatically in Fig. 2. The film contains the two component pictures which are merged into one on the picture screen through objective and special prisms. At the same time the beams of rays corresponding to pictures 1 and 2 pass each through a polarizing filter. The spectator will view these pictures through spectacles having two corresponding polarizing filters. The beam of light I appertaining to picture 1 is allowed to pass through the spectacle glass 1, while beam II is extinguished. The beam proceeding from picture 2 passes through the spectacle glass 2, while beam I proceeding from picture 1 is extinguished in this spectacle filter.

Either eye will therefore see only that picture which appertains to it. The brain restores the fusion of the two pictures into one, so that objects and persons are seen as they appear in nature. We now come to the question as to what is needed in order to render a projector of standard type available for projecting stereo pictures. These requirements comprise:

1. *As to the projector*:
   (a) An optical front attachment for the projection of the component pictures by means of the polarizing filters.
   (b) A source of light of high intensity.
2. *As to the picture screen*: Metallized linen.
3. *Spectacles with polarizing filters.*

● Screen, Spectacles

As already described, the stereo front attachment with the incorporated prisms serves for the projection of the component pictures upon the screen in their correct position. This attachment can be appended to any standard projector. This stereo attachment contains, in addition, the two polarizing filters. The losses of light which are inseparable from the presence of the prisms, the polarizing filters, and the spectacles worn by the spectator must be made up by the use of lamps of increased power.

To some extent this loss of light is made good by the use of a silver screen because of its well known much higher reflecting capacity. This silver screen, as already mentioned, is needed for another reason. The polarized light is required to retain its state of polarization. This implies that reflection should take place at a metallic surface. An ordinary screen would have what is called a depolarizing effect, that is to say, it would cause the light again to oscillate in all directions. Since picture screens of the normal type have as a rule a restricted angle of dispersion, spectators occupying side seats do not see the picture in its full brightness. Screens are, however, in course of preparation which will have a large angle of dispersion, that is to say, which will reflect the light fairly evenly in all directions.

Now, as regards the spectacles: The older procedures, in which likewise use was made of spectacles, did not obtain a permanent hold, but this was not by reason of the use of spectacles but rather because the colored filters used were very liable to subject the spectators to color flicker. In the case of the new polarizing filter spectacles this does not arise. Spectacles as such are not responsible for failure of the further development of the older attempts. The fault lay in the nature of the spectacles.

It may be regarded as a detracting feature of the stereoscopic motion picture that spectators are required to put on spectacles in order to see it. When, however, it is considered that in these days everyone is ready to wear protective spectacles in glaring sunlight, the incidental use of spectacles should not be looked upon as a serious obstacle to the success of the stereoscopic picture. As it happens, the requisite spectacles are now made at a very moderate cost. It is naturally difficult to say whether the stereoscopic film will secure a foothold in the motion picture theatre, especially in film plays. It may, however, be regarded as certain that it has great possibilities in the service of advertising and educational presentations.

The exhibition of a stereoscopic advertising film with the Zeiss Ikon equipment, as referred to, has certainly demonstrated that the public follows such a film with enthusiastic interest, showing that it is competent to rivet public attention upon the contents and details of such films.

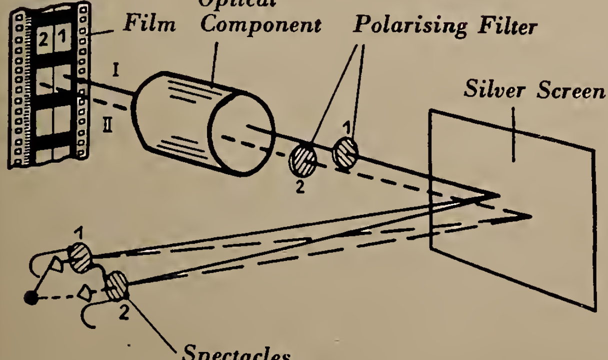


FIGURE 2

Path of the rays in the projected light

MORELITE STEREO ATTACHMENT

Morelite announces a stereopticon attachment with their latest model MON-ARC lamp, burning Suprex carbons, the only lamp of its type so equipped. Lack of space with this type of lamp prevents its attachment between the front of lamphouse and projector. Morelite's stereopticon is attached to the left-side door through an opening of which it receives its reflected light-beam from a Moroni metal mirror enclosed in a frame. The latter is located inside of lamphouse and substitutes for the front dowser when the stereopticon is operated. A half turn of a knob outside of lamphouse transfers the light beam from showing motion picture to still picture of slide on screen and *vice versa*, without moving either the lamp or the stereopticon. The light beam for the latter passes unobstructedly to the screen with any type of projector.

Screen illumination is much brighter than that obtained from any other stereopticon whether attached to a low-amperage lamp or employing a bulb. Overheating is efficiently controlled even with the largest carbons through a minute movement of the lamp mirror, thereby permitting a still to be shown for five to six minutes without cracking the glass slide. Complete details available from 600 West 57th St.

Television Makes Debut At San Francisco Fair

Visitors to the Golden Gate Exposition at San Francisco will not only see practicable home television demonstrated, but will themselves have an opportunity to be televised. Radio facsimile, which will print news bulletins, pictures and other text in the home, will also be shown.

Visitors to the television studio may stand before the television camera and be seen and heard by other visitors in an adjoining room to whom they will also be visible through a glass window. In the viewing room, the images will be seen in black-and-white on the fluorescent surface of the Kinescope receiving tubes, either directly, or as reflected from a mirrored surface. These tubes are 12 inches in diameter and give an image approximately 8 x 10 inches in size.

In the studio, on the transmitting end, the Iconoscope tube, or electric eye, corresponds to the film in an ordinary camera, except that the Iconoscope converts optical images into electrical impulses. The camera lens focusses the subject onto a plate that has been coated with millions of miniature photocells. These tiny light-sensitive elements store up or lose electrical charges that correspond exactly to the light and dark portions of the subject. At the other

end of the Iconoscope tube is an electron gun, which directs a sharply focussed beam of electrons onto the plate in a rapid back-and-forth motion, a line at a time, until it has covered the entire surface of the plate, converting the image into electrical impulses.

At the receiving end, the Kinescope tube reverses the transmitting process. The incoming signals are amplified and made to control the intensity of an electron beam which bombards the luminescent surface of the tube. This bombardment builds up the picture by a back-and-forth motion, a line at a time for 441 interlaced lines, at such a high rate of speed (4,500 miles per hour) that the resultant picture looks complete to the human eye at any given moment.

HUGE SPEAKER FOR FAIR

The perisphere, which in conjunction with the 700 foot Trylon has become the symbol of the New York World's Fair, has been utilized by RCA sound engineers to form the horn of the largest loudspeaker ever constructed—a sound reproducer so vast that thousands of persons will be able to stand at one time at its periphery.

A battery of 36 high- and low-frequency sound reproducers will be installed in a large concrete chamber below ground level at the base of the perisphere. This chamber which is entirely concealed from view, will effectively couple the reproducers to the horn created by the perisphere and the surrounding ground surface forming a horizontal 360-degree circular speaker. The massive unit is designed to cover the audible range of sound from 20 to 10,000 cycles. It will reproduce sounds so low that they will be felt rather than heard. This 200 foot ball, set approximately 4 feet above the ground, gives a circular horn 100 feet in depth, 4 feet at the throat and 100 feet at the mouth opening.

Of especial interest will be the sound in conjunction with the Theme Show in the interior of the perisphere. Twelve especially designed 36-inch high fidelity loudspeakers will be mounted near the top of the ball-shaped interior, projecting sound onto the moving platform, on which the spectator will view the "World of Tomorrow." Music and sound effects from this system will be synchronized with the picture action.

IMPROVED FILM BUSINESS FOR '39 FORECAST BY POOR'S

The motion picture industry should experience a better-than-seasonal improvement in domestic theatre attendance and box office receipts during the 1939 first half, reflecting increased consumer, pending power, according to a Poor's Survey report. Continuing, the report states:

"Detracting from the favorable fundamental position, the Government's anti-monopoly litigation is proving disturbing. Designed to divorce theatres and studios and aimed at the elimination of 'block-booking' and other trade practices, the Federal law suit may be expected to result in numerous changes within the industry. At this juncture, it is difficult to forecast the ultimate outcome.

"One thing appears logical, however. Should motion picture producers be forced to eliminate their theatre investments from their corporate setups, common shareholders would receive their pro rata equity through stock distribution. As for 'block-booking,' its elimination might prove beneficial to producers over the long term, in that it would force economies and efficiency in film production."

VISUAL EDUCATION BOOK

Free Films for Schools lists alphabetically 1400 free films from over 300 sources throughout the U. S. Cross references—under 60 different headings show at a glance what films are available for school projects. Physical data of each film is recorded, the number of reels, whether 16mm. or 35mm. and whether sound or silent. Gives addresses of sponsors or distributors of each film.

Published at 25c by the DeVry Corporation, 1111 Armitage Ave., Chicago, Illinois.

PROJECTION UNITS TOP THEATRE PURCHASES, SAYS W. E. GREEN

Of 104 theatre owners who recently modernized their houses with National Theatre Supply Co. equipment, 40% put the bulk of their purchase right in their projection rooms, according to President Walter E. Green. These betterments in projection and sound were, said Mr. Green, the first line of offense in drives for more business.

Included in the purchases were orders for 18 new Simplex E-7's, 36 Super-Simplex projectors, 22 Simplex Four-Star sound systems, 48 pair of Peerless lamps and 60 Walker screens.

ACADEMY AWARDS FOR 1938

"You Can't Take it With You" (Columbia) won the Academy Award as the best production of 1938, the director of which, Frank Capra, also won top honors in his division. Other awards went to Bette Davis, best performance ("Jezebel"); to Spencer Tracy, best performance ("Boys' Town"); to Fay Bainter and to Walter Brennan for the best supporting performances; to Joseph Ruttenberg for the best cinematography ("The Great Waltz"); and to T. Moulton for the best recording job ("The Cowboy and the Lady").

ERPI'S NOVEL SOUND SYSTEM FOR G. M. FAIR EXHIBIT

A gigantic sound reproducing system, the main unit of which weighs approximately twenty tons, has arrived at the N. Y. World's Fair for the General Motors "Highways and Horizons" exhibit building. Capable of delivering 150 different descriptive talks at the same time, the voice system will be perfectly synchronized to 300 comfortable chairs, mounted on a continuous moving escalator and each accommodating two spectators as they tour the mammoth 30,000 square foot exhibit panorama. Visitors will have the sensation of soaring for many miles over vast areas of countryside, industrial and mountainous sections, through towns and cities of the future and, by means of the intricately designed voice instrument, each spectator will hear an intimate, personalized description of the numerous vistas at the same time he is viewing the scenes.

The speaker system is constructed on a finely wrought steel drum, 8 feet in diameter. The drum rises 12 feet into the air from a circular base, which houses its motor. The drum revolves, carrying shimmery ribbon bands of sound film in front of tiny light needles, whose variation is no greater than one-thousandth inch. Seven main structural supports protect a multitude of small amplifiers and curve over the top of the vertical drum to meet and steady the shaft.

SIMPLEX LECTURE IN ROCHESTER

A lecture-demonstration of the new Simplex E-7 projector was given on Feb. 23 under the auspices of Rochester, N. Y. Local 253 as part of its regular educational program. The meeting, which was followed by a buffet supper, attracted an attendance of more than 100, including members of many Western N. Y. State local unions. John Krulish and P. A. McGuire were the International Projector Corp. representatives.

PIPE MUSIC INTO HOME

Muzak, a subsidiary of Warners, selling wired radio to restaurants and grills, has a new service whereby its own musical transcriptions, plus regular radio programs from specially selected radio stations will be made available to apartment and home dwellers in New York at a cost approximately that of a telephone. This is direct competition for radio set manufacturers.

Monthly charge for receivers will be $3.50 and $5 for a small and large receiver, respectively. In addition, Muzak has another plan whereby apartment dwellers will be offered the choice of four leading broadcasting stations in the metropolitan area. Reception will be guaranteed without static or fading.

SCHINE RENEWS ALTEC PACT

The Schine Circuit has renewed sound service contracts with Altec Service Corporation for the coming year, covering 105 theatres in the Middle Atlantic states.

C. J. Zern has been appointed manager of the Kansas City district of the Altec Service Corp. with headquarters there.

NEW MERCURY TYPES FEATURE 1938 LAMP DEVELOPMENTS

A new era in artificial lighting was initiated during 1938 with the introduction of fluorescent Mazda lamps, hailed as the greatest single development of light production in many years. The spectral quailty of light from the daylight lamp is the closest approach to natural daylight that it has ever been possible to produce by any artificial illuminant at an efficiency even approaching that of these lamps; and, similarly; the efficiencies with which these lamps produce colored light have never been approached previously. Colored light is produced in hitherto unobtainable pastel tints as well as in pure colors.

The tubular lamps contain a small globule of mercury and a small amount of argon gas at low pressure, and pre-heated coiled tungsten wire electrodes covered with an electron-emissive material. The low-pressure mercury arcs produce ultra-violet radiation which activates the fluorescent chemicals, or phosphors, with which the inside surfaces of the tubes are coated. The phosphors are energy transformers—they step the invisible ultra-violet radiation down to the visible part of the spectrum. By proper selection and blending of the phosphors, it is possible to produce radiation in practically any desired part or parts of the spectrum. Fluorescent lamps, available only a few months, already

have found applications in many different lighting fields.

A new mercury lamp surpasses in brilliancy most known illuminants: the arc attains a brightness of the order of 30,000 candles per sq. cm. Highest in wattage and smallest in size of all the mercury lamps, the new 1000-watt water-cooled lamp, with an efficiency of 65 lumens per watt, is a quartz capillary tube about 3 inches long, containing a small amount of mercury and fitted at each end with a brass ferrule for electric contact.

The arc stream itself is less than an inch long and scarcely larger in diameter than an ordinary pin. The intense heat generated by such an arc would melt even the quartz tube almost immediately if some effective method of removing the heat was not employed; the arc tube is operated in a rapidly-moving stream of water within a glass water jacket.

This new lamp promises to make an important place for itself in the fields of photoengraving and blueprinting. It requires less current than do other light sources used in photoengraving, produces superior work because of the steadiness of the arc, and makes it possible to produce clean cut engravings of poster size. For blueprinting it makes possible increased printing speeds, more compact equipment, and in some cases lower wattages. The lamp is also being considered as a light source for searchlights of certain types.

Also introduced during 1938 was a new projector lamp in which a reflector of highly accurate contour and a lens plate are actually parts of the lamp itself.

THEATRE DIVORCEMENT DELAYED BY NO. DAKOTA REPEALER

Repeal of the No. Dakota theatre-divorcement law will block consideration of the constitutionality of this statute by the U. S. Supreme Court, to which an appeal was taken by the affected producers and distributors. Whether the repeal action will prevent or merely retard divorcement is a moot question, although there is apparent in producer-distributor circles a noticeable trend toward the grouping of circuit theatres under separate theatre-operating corporations.

This latter action would not disturb the Labor setup in the circuit theatre field, since actual control would continue to be vested in the real owners—producers and distributors—irrespective of theatre-operating personnel. That which will really affect circuit theatres is the anticipated modification, at least, of existing block-booking practices and a drastic change in clearance schedules.

THE LANGUAGE OF LIGHTING

(*Continued from page* 15)

ing to the laws of subtractive mixture. In the application of light, wide use is found for both the additive and subtractive methods.

● Producing Colored Light

Gaseous tubes are coming into wide use for the production of colored light. Filters which absorb all the colors except the one desired from an incandescent source are also widely used for this purpose. For example, if red light is to be produced, white light is passed

through a red-colored filter. Various substances are used for filters such as glass, gelatin, lacquer, fabric and pigments. The choice of color media is determined by the manner in which they are to be used, and the desired permanency of the installation.

In another method of producing colored light which will probably play a large part in the lighting of the future, fluorescent materials are used in conjunction with light sources such as the low-pressure mercury arc. With sources of this kind, it is possible to produce from fifty to two hundred times as much light as can be obtained by filtering the light from an incandescent lamp.

At times it is important to reproduce the color quality of average daylight for purposes of proper identification or matching of colored objects. For example, it is usually desirable to see the daylight appearance of fabrics, even though they be viewed at night.

For reproducing daylight, a blue color filter may be used with an incandescent lamp, allowing the transmission of only the proper proportion of each wave band to give the desired color quality of the transmitted light. For approximate results the daylight lamp or enclosing globes of blue glass may be used, but wherever accurate identification must be made or if the results must be scientifically reproducible, special color filters must be used; they may be obtained commercially.

● Psychology of Color

In spite of an apparent relationship between color in both pigment and light and human behavior, definite scientific facts on the subject are few. The illuminating engineering profession has been hesitant about accepting as scientific theory certain interesting reactions which many observers have duplicated from time to time but as yet not invariably enough to develop a definite psychology of color.

However, a review of these few investigated facts relative to color and its effects on human reactions should prove interesting to the illuminating engineer even though, as yet, they cannot be given the benediction of science.

Many investigations over a period of years have indicated a marked difference in color preference between men and women. Men prefer blue and women red, when color in the abstract is involved, disassociated from current fashions and other factors that might prejudice the subject. Investigation shows, however, that the second choice for men is red; while that for women is blue; hence this preference is marked but not always definite.

Both sexes, however, react favorably to bold colors and show definite preference for strong primary colors of great vividness when these again are disassociated from current fashions in dress or other factors likely to affect the selection. This fact is of great significance in advertising and decorating to attract attention, and is another reason for the predominance of such colors in outdoor advertising, in addition to the advantage of their greater distance visibility when properly used.

● Contrast and Variety

It must be emphasized that, in the foregoing section, colored pigments alone were considered, for when colored lighting is investigated, almost the exact opposite in preference of men and women is noted. Men like the warm colors of light, the yellows and ambers for instance; and women like the cold colors of the spectrum. The theatre and the displayman frequently make use of this knowledge in their

WORLD'S FAIR 16 MM. JOBS

Already assured of all 35 mm. projector jobs at the forthcoming World's Fair in New York, Local 306 is pressing hard for 16 mm. unit jobs on the Fair grounds. Four 16 mm. projectors are regarded by Local 306 as a unit, with one man per unit. Tentative scales compare favorably with those paid on 35 mm. jobs.

efforts to influence people. Again it must be pointed out that this noted preference is with colored light in the abstract, and that in practice, contrast and variety are important factors in using color in a pleasing manner, regardless of the sex of the observers.

The use of the adjective "warm" to describe red, amber, and yellow light, and "cool" to designate blue, green, and bluish-white light, is very significant for it is a matter of general observation that rooms lighted in the former colors give observers a definite feeling of bodily warmth; while rooms lighted in the latter colors "feel" cool. These facts are frequently used in interior lighting, changes being made in the color lighting for winter and summer. Again the displayman would do well to follow suit, using light of a cool nature on refrigerator displays, and warm colors of light on bathing suits, by way of example.

Moreover, yellow and amber tinted light is definitely stimulating, and has been known to increase the pulse rate of the more emotional types of people; while bluish-white, and other cool colors of light are restful and soothing, provided the color is not too strong and definite. Purple and violet light are depressing and uncomfortable to a marked degree.

In fact, the human race as a whole, men and women, do not like bold, vivid colors in lighting, regardless of the wavelength employed. They do like, however, tinted light, and in the future the color of the light will undoubtedly play an increasingly important part in the home, factory, and store, as well as in the theatre and for display where already it is used extensively and to advantage.

ANALYSIS OF BRUSH ACTION ON COMMUTATING UNITS

(*Continued from page* 10)

even when no sparking is visible at the trailing edge.

Dull markings in the central portion of commutator segments, parallel to the edges, are sometimes caused by this sparking underneath the brushes. In the presence of a high-resistance glaze, such sparking punctures the commutator film and is one cause of the small spots of bare copper sometimes seen on an otherwise uniformly glossy surface. This localized breakdown of the film releases particles of copper which may become imbedded in the brush faces and cause streaking of the commutator surface. The localization of current which follows such streaking often necessitates resurfacing of the commutator in order to restore normal conditions and satisfactory brush performance.

Humidity has been found to have a noticeable influence on the performance of metal-graphite slip ring brushes. During winter periods of extremely low humidity, excessive dusting and rapid wear of slip ring brushes is of frequent occurrence. Air conditioning has been utilized to overcome this trouble. The effect of humidity on commutator brushes is less marked than on slip ring brushes and some undesirable effects may result from high humidity.

Humidity probably has a favorable effect on friction as long as an unbroken surface film is maintained on the commutator. However, there are indications that excessive humidity may be a source of electrolytic action under the brush face, causing deposition of copper on the faces of the cathode brushes, that is, the brushes receiving current from the commutator or slip ring. If this effect is sufficiently pronounced, the imbedded copper may break up the com-

mutator film, impair commutation and, in severe cases, cause commutator threading.

Temperature undoubtedly has a pronounced influence on brush performance. However, the most important effects of temperature are probably transient in character, that is, they are related to the highly localized temperature conditions momentarily established at the points through which current passes between brush and commutator. As previously pointed out, these localized areas of current transfer are of three types: points of solid contact between the carbon brush and the commutator surface, contacts established by bridging particles of conducting material, and points at which current passes in the form of minute arcs.

Very high local temperatures exist at the points where arcing transfer occurs, somewhat lower temperatures at the points of particle contact, and still lower temperatures at the points of solid contact. Even at the latter points, however, transient temperatures attain a value much higher than the average interface temperature which is, itself, considerably above average commutator surface temperature.

It seems probable that these local temperatures at times reach values at which ionization of surrounding materials and gases exerts an important influence on commutation phenomena. However, since these points of extreme temperature are underneath the brush face and so highly transitory in character, it is extremely difficult to analyze the exact nature of their effect on brush performance.

Obviously, the average temperature of the commutator has an influence on factors such as commutator distortion, loosening of segments and surface oxidation, but, in respect to interface conditions, it has little influence beyond establishing the temperature plane upon which the much higher transient temperature conditions are superimposed.

(TO BE CONTINUED)

TELEVISION AND THE MOTION PICTURE INDUSTRY

(*Continued from page* 13)

about 50 to 1 for large areas and 10 to 1 in details. Experimental Kinescopes have been built in which the luminescent screen is deposited on a thin sheet of glass which is mounted inside a transparent glass bulb. Such tubes are capable of a considerably greater range between large areas and in details.

Discussion:

Mr. Crabtree: When televising an outdoor subject, what is the threshold light-intensity necessary for reproduction, as compared with that necessary when photographing with an $f/2$ lens in combination with the high-speed film emulsion we now have available?

Mr. Beers: With various standard and special pick-up tubes, we can get pictures

under any lighting conditions in which you can take pictures on film.

Mr. Crabtree: In other words, you can reproduce satisfactoily a football game about half an hour after sunset on a rainy day?

Mr. Beers: Yes. We have obtained recognizable pictures in which the subject had a surface brightness of 1 or 2 foot-candles.

Mr. Carver: I do not understand whether you have a flicker blade or not, or whether it is or is not necessary.

Mr. Beers: There is no flicker blade, as such. A flicker blade is not necessary in television, due to the way in which we reconstruct the image. We produce on the end of the tube a certain number of images a second, and that controls the flicker. Nothing in the projector has anything to do with the manner in which the images are actually reproduced.

Mr. Carver: What do you do when the film is being pulled down? There is no picture on, and there must be a dark space.

Projection Process Limitations

Mr. Beers: You are actually seeing the picture when the film is being pulled down. During the pull-down we scan the electrical image that remains on the mosaic of the Iconoscope. That is when we see the image at the receiver. The picture is projected when nothing is seen at the receiver. That is the interval in which we transmit the synchronizing signals.

We have two choices in television. One

is to attempt to scan the picture on the mosaic of the Iconoscope during the time the picture is actually being projected there. That means then that we have to pull down the next frame of film during the time we transmit our scanning signals, which is approximately 1/800 of a second. That imposes some physical requirements on a projector we have not been able to meet. We have not been able to conceive of a projector on which the frame can be pulled into place in 1/800 second without tearing the film.

The easier way is to pull the film into place in the gate during the long interval of time and to project it on the Iconoscope mosaic during the short time interval; and then to scan it, while the optical image is no longer on the mosaic, using the electrical image that is stored there.

Mr. Friedl: Reference was made to mechanical systems in England and the speeds with which these systems operate. Can someone throw some light on the question of mechanical system *vs.* the electronic systems?

Mr. Goldsmith: The electronic systems offhand seem to be most appropriate because electrons are weightless and are readily controlled in flight and form a sort of "air-brush" for painting pictures which can be moved rapidly and readily. The only mechanical system that seems to be seriously considered commercially today, at least in England, is the one Mr. Kaar mentioned, the Scophony system, in which essentially there is a storage capacity, because of a diffraction phenomenon of standing waves of supersonic frequency in liquid, actuated by a vibrating quartz crystal. In this system one may scan a half line at a time (about 200 picture elements).

This system, however, as Mr. Kaar pointed out, employs a motor running at some 30,375 revolutions per minute for the high-speed or line deflection of the spot, and a smaller motor, running at a lower speed, for the frame scanning, two mirror systems, the supersonic cell, some lenses, and a mercury-vapor capillary lamp for the light-source. The picture produced is 18 x 24 inches in size.

The competitive devices in England are, for example, the Phillips receiver which produces an 18 x 24-inch picture by projection from approximately a 3-inch projection type cathode-ray tube.

The prices on the British market today are $850 for the Phillips receiver producing the 18 x 24-inch picture, and something over $1100 for the comparable Scophony receiver, but nobody has given reliable data as yet as to the relative performance, life, and economics.

The receivers in England run in the price range from $125 to $150 (for the picture only) in a chair-side type. Receivers for larger pictures run up to $300 or $400, with top figures of $1200 for very large pictures (18 x 24 inches) with sound and all sorts of extra attachments, phonographs, and the like.

Mr. Beers: If it were economically possible to use 24 frames in television it would be done. It is theoretically possible, but the increased amount of filtering and shielding necessary in the receiver to make it perfectly satisfactory from the standpoint of eliminating the moving images resulting from the 60-cycle power-supply system make it economically impracticable.

Mr. Roberts: When scanning 24-frame motion pictures at 60 or 30 cycles, do you get any time-distortion in the presentation of the picture? Would there be any unexpected effect as a result of seeing one frame longer than the one before it?

Mr. Beers: We have noticed no more distortion than is normally noticed in motion pictures.

Pickup Method Elective

Mr. Crabtree: Do you think the trend will be to record directly by means of television scanning, or that the subjects will be photographed on motion picture film previously to scanning? What are the relative merits of the two processes —direct scanning and transmission at the scene, as against photographing the scene and then bringing the film to a central transmitting station.

Mr. Beers: That is a program problem. Either can be done. The scene may be taken on motion picture film and then converted into television program material; or, as you know, we have a mobile unit which can be taken out to the scene and there televise it and transmit its picture directly by relay to the transmitting station.

Mr. Schlanger: Am I to understand that the television picture is equal in quality to a 16 mm. picture projected with a 250-watt lamp and of comparable size and viewing distance?

Mr. Beers: From the standpoint purely of picture detail they would be comparable. I stated that the film was processed to produce duplicate films. If you take standard home motion picture on reversible film, you will have somewhat better detail, but with ordinary commercial processing of duplicate films, I think that the picture detail of the two will be comparable.

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MARCH 1939

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New RCA PHOTOPHONE MAGIC VOICE OF THE SCREEN Makes Triumphant Debut!

MORRIS A. MECHANIC, PRES.

VERNON 9454 CENTRE THEATRE
NORTH AVE. AT CHARLES ST., BALTIMORE, MARYLAND

February 9, 1939

RCA Manufacturing Co., Inc.,
Photophone Division, Camden, New Jersey

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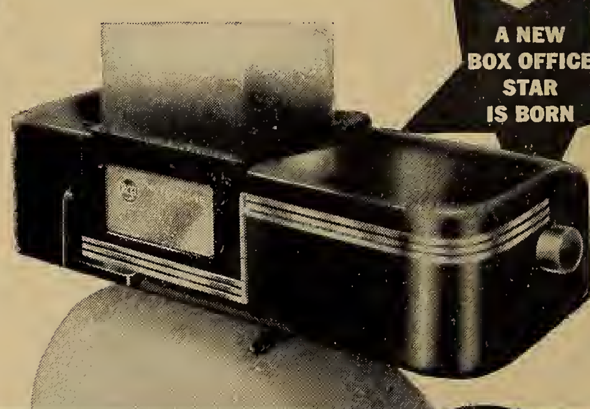

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International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

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Monthly Chat

PRODUCTION schedules for the coming film season indicates a substantial boost in the number of color prints, including short subjects. Which news is most welcome. We observe in passing, however, that Technicolor states that the density of its prints is controlled to produce "a satisfactory screen image when light falling on the screen, measured with the projector operating without film, is approximately ten foot-candles."

Now, just what reading in foot-candles this will insure even in theatres having modern arc lamps we can't figure out at the moment, but we'll wager that it falls far short of approved practice. At the moment we're focusing on those 5000 theatres which still use low-intensity lamps, the result of which is to make a color print a travesty on efficient projection. To what avail does Hollywood wallow in an ocean of Technicolor prints—at about twice the cost of black-and-whites?

• • •

Bausch & Lomb Optical Co. will announce shortly a new series of vastly improved projection lenses which are expected to give more and better light. These lenses, one of which may be an *f*1.9, are expected to soothe the feelings of those projectionists who clamor for better optics as a means for increasing light output to the screen. Of course, improved optics is only one angle of this many-sided problem—but it definitely won't clean a dirty screen.

• • •

Three projectionist fatalities during the past five weeks as a result of theatre film fires. Oklahoma Supreme Court please note. Incidentally, what is the state or district organization doing about this august body's recent decision that projection is a "non-hazardous occupation"?

• • •

Many recent releases attest to the need for compliance by Coast studios with the request of the SMPE Projection Practice Committee that a margin of safety be allowed when shooting a picture so that the heads and feet of actors, and other content, not be cut off. Cameramen still insist upon shooting to the extreme limits of the aperture, with results that are all too apparent to require extended comment herein.

• • •

JOTTINGS: Avoid signing for television "courses" before careful investigation . . . We are preparing a little table showing the utter futility of operating Suprex arcs as much as 10 amperes above approved rating — for those doubters who, without any supporting evidence, disputed our earlier remarks anent this topic . . . Coming up: more studio stuff, including that much-requested data on the course of a print from camera to theatre. Also, a new series on math. written especially for you, Mr. Projectionist.

INTERNATIONAL PROJECTIONIST

VOLUME XIV NUMBER 3

MARCH 1939

An Analysis of Brush Operation on Commutating Equipment

BY ENGINEEERING DIVISION, NATIONAL CARBON COMPANY

II.

BRUSH friction is an item of major importance in relation to brush performance affecting, in substantial degree, the total mechanical energy loss of the machine, the commutator temperature and the quietness of operation. Since friction results from the relative motion between the commutator surface and the brush face, anything which affects either surface, or the intimacy of contact between these surfaces, has an influence on the friction experienced in operation. Consequently, the study of brush friction is complicated by many factors difficult to define and even more difficult to control.

Perfectly smooth surfaces, sliding one upon the other, represent an ideal condition never realized in practice. Interlocking of microscopic irregularities in the contacting surfaces is, possibly, the primary source of frictional resistance. In this instance the magnitude of the friction loss depends upon the ease with which these points of interference can be broken away from one surface or the other or allowed to ride over one another as a result of deformation or separation of the surfaces.

Hard particles, imbedded with sufficient firmness to resist displacement, cut their way through the contacting surface. This, together with similar action by free particles of sufficient hardness, is the source of mechanical abrasion. Abrasion resulting from firmly imbedded particles naturally increases the friction loss, and, for this reason, most abrasive brushes show a high coefficient of friction.

With soft, graphite brushes, however, a low coefficient of friction may be observed in the presence of appreciable abrasive action. Natural graphites contain a certain amount of gritty material, not all of which is removed in the refining processes applied to commercial grades. These gritty particles are the source of the abrasive action frequently observed with natural graphite brushes. However, due to the relatively weak mechanical structure of graphite, the points on the brush face which interlock with irregularities of the commutator surface break away with little resistance.

Furthermore, as loosened particles of graphite undergo the shearing action produced by the motion of the commutator under the brush, they continue to break down into smaller and smaller particles, filling up minute surface irregularities and enabling protruding points to ride over one another with relative ease. In this manner, the graphite acts as a lubricant between the contacting surfaces, maintaining low friction even in the face of appreciable abrasion.

The effect of free particles under the brush face may be either favorable or unfavorable with respect to friction, depending on the nature of the particles. Consider an iron casting being dragged over a concrete floor. The friction is high but, if ashes are thrown in front of the casting, it can be dragged more easily. This is because the ashes fill up some of the irregularities in the surfaces

and offer little resistance to further pulverizing from the shearing action produced by motion of the casting over the floor.

If marbles were placed under the casting, resistance to motion would be still further reduced by the rolling action of the marbles. Irregular fragments of glass or stoneware, on the other hand, by increasing the number of points of interlocking contact between the casting and the floor, might make the resistance to motion greater than that experienced on the bare floor.

Graphite particles between brush and commutator, as previously described, reduce friction in the same manner as ashes thrown on the floor. Particles of substantially uniform diameter, freed from either the brush or the commutator surface, may, like the marbles, reduce friction by their rolling action. Hard particles of irregular shape may, on the other hand, result in higher friction.

Among the many advantages of lampblack base. electro-graphitic brushes are these: they do not contain gritty particles to abrade the commutator; they contain sufficient graphite to provide lubrication and to aid in the development of a desirable surface film on the commutator; the extreme fineness of the lampblack particles tends to reduce friction by rolling action when these particles are loosened from the body of the brush; finally, the firmness of bonding prevents protruding points being broken off in jagged form and allows them to be worn into conformity with the general contour of the contacting surfaces.

● Brush Pressure

The pressure at which brushes are held in contact with the commutator is a matter which should be given careful attention. The pressure should be equal on all brushes to avoid the difficulties arising from selective action, that is, unequal distribution of current among the different brushes on the machine.

There is also a limited range of pressure within which best brush performance is obtained. If the pressure is too light, imperfect contact with the commutator is liable to result. This is a frequent source of sparking, injury to the commutator surface and undue brush wear. Excessive brush pressure results in unnecessary friction, needless wear, and, under certain conditions, may even reduce the stability of the brush position in its holder and against the commutator.

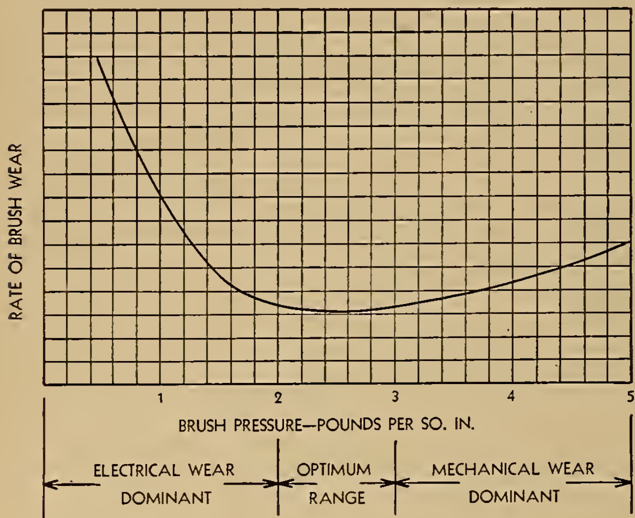


FIGURE 3

Relationship of brush pressure and rate of brush wear for lampblack base, electrographitic grades

There is a reasonably wide latitude of pressure within which satisfactory performance can be expected. The limiting values of this optimum range vary with different types of brushes, but no difficulty from this source need be expected if the recommendations of the brush manufacturer are followed.

Brush wear is not necessarily reduced by reduction of brush pressure. In fact, at pressures appreciably below the recommended optimum range, brush wear increases very rapidly. Electrical causes predominate as the source of brush wear at low temperatures. Increased brush wear is also encountered at pressures above the maximum recommended but the rate of increase is less for pressures above the optimum range than it is for those below.

At high pressures, mechanical wear predominates. This relationship of pressure to brush wear is illustrated in Fig. 3 for lampblack base, electro-graphitic grades. Similar effects may be observed with all grades of brushes, but the range within which best performance is obtained is different for different grades.

● Commutation Factor

Frequent mention has been made of the importance of firm contact between the brush and the commutator. The nature of the surface film on the commutator, atmospheric conditions, frictional properties of the brushes, brush pressure and angle of indication to the commutator all have an influence on the intimacy of contact at the brush face.

Another factor, possibly more important than any of the foregoing, is the elastic property of the brush. It is subject to accurate, quantitative determination and, because of its direct influence on commutating performance, is defined as *commutation factor.* Several years of experience with applications under widely varied conditions of service have demonstrated the importance of this property in respect to brush operation.

By selecting a brush of suitable commutation factor, intimate contact between brushes and commutator can be maintained, with good commutation and quiet operation, in the face of disturbing conditions that could not readily be overcome in any other manner.

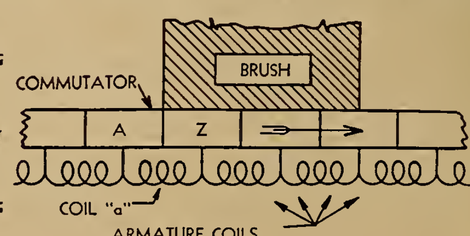
● Contact Drop

Contact drop has long been the criterion by which the commutating properties of a brush are judged from an analysis of characteristics determined in the laboratory. However, there is good reason to believe that other characteristics, such as reasonably low coefficient of friction, good commutation factor and ability to maintain a good surface film on the commutator are of equal importance in avoiding injurious sparking.

The importance that has been placed on contact drop is largely based on the assumption that, inasmuch as some voltage is present in the short-circuited coils of the armature during the commutating period, current must flow during the entire period of short-circuit through the brush face from segment to segment parallel to the commutator surface—that is, through the thickness of the brush.

FIGURE 4

Conventional diagram illustrating commutation interval



Since the electrical resistance through the armature coil, the segments and the short path through the face of an ordin-

ary carbon or graphite brush is low, it is further assumed that the voltage drop through the resistance of the two segment-to-brush contacts, included in this short-circuit path, must approximate the voltage in the coil if excessive short-circuit current is to be avoided.

This theory has led to the development of various special types of brushes having a laminated structure or very high cross-resistance to aid in the control of this short-circuit current. The error in this theory is that it overlooks the fact that, in addition to the current from the short-circuited coil under consideration, current is flowing in each segment to or from an adjacent coil to which it is connected.

If the commutating conditions of the machine are correctly compensated, by brush position or properly adjusted interpole field, current flows in only one direction between commutator and brush and there is no short-circuit current in the brush face. This is shown by the fact that, on a properly adjusted machine, the voltage drop between brush and commutator shows no reversal of direction at any point from leading to trailing edge. However, in the case of over or under compensation, reversal of voltage will be observed and, in such cases, short-circuit current will flow in the vicinity of that portion of the brush face where the normal direction of voltage is reversed.

Although there is no actual short-circuit current in the brush face under good commutating conditions, it sometimes simplifies the analysis of certain phenomena of commutation to consider the unidirectional current through the brush contact as having two components, one the load current of the armature and the other a localized current through the short-circuited coil and the brush face.

It is customary, in discussing problems of commutation, to use this method, treating load current and short-circuit current as separate and co-existent phenomena. In the following discussion, however, the commutation cycle will be analyzed on the basis of resultant current at successive points across the brush face.

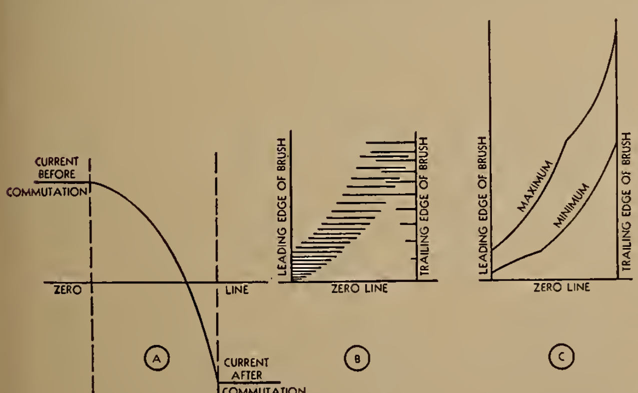


FIGURE 5

A—Normal curve of commutation current

B—Current in commutator segment at successive positions

C—Range of current density in brush face

The circuit diagram for coils undergoing commutation is shown in conventional form in Fig. 4. Fig. 5-A represents a normal curve of commutation current. The ordinates of this curve indicate the value and direction of the current in coil "a" (Fig. 4) during the commutation interval, and the abscissae indicate the position of the division between segments "A" and "Z" across which coil "a" is short-circuited by the brush.

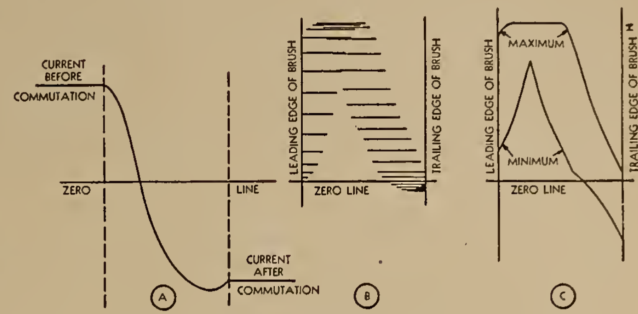


FIGURE 6

A—Curve of commutation current indicating over-compensation. B—Current in commutator segment at successive positions. C—Range of current density in brush face

The current flowing through segment "A" as it passes under the brush is indicated by the horizontal lines in Fig. 5-B. The lateral location of these lines indicates successive positions of segment "A" in relation to the brush face, and their distance above the zero line represents the value of the current flowing through the segment at the positions indicated.

The corresponding range of current density at various points across the brush face, is shown in Fig. 5-C. The full cycle of variation between maximum and minimum limits of current density at any point on the brush face has a frequency equal to that at which the commutator segments are passing that point.

The values of current density here represented assume contact with the brush over the full surface area of that portion of the segment under the brush at any given instant. No attempt has been made to evaluate the much higher transient current densities encountered at the relatively small number of points at which contact usually occurs.

Exact repetition of a particular group of curves, such as shown in Fig. 5, will occur in adjacent coils and segments only in an armature with perfect electrical balance and having only one coil per slot. Where there is more than one coil per slot, the second will commutate under slightly different field conditions than the first, and the third under conditions differing from both the first and second. Therefore, between segments in which essentially identical conditions recur, there may be one or more intervening segments in which the cycle of commutation is somewhat different. This is the reason for the second or third bar marking frequently observed on the commutators of machines having two or three coils per slot.

Figure 6-A is typical of the commutation curve encountered under conditions of over-compensation. It will be seen from Figs. 6-B and 6-C that reversal of current occurs in the segments shortly before passing from under the brush, with corresponding reversal of current in that portion of the brush face. Under such conditions intermittent short-circuit current flows in the brush face near the trailing edge, and a voltage drop curve across the brush face shows reversal of direction near the trailing edge.

With under-compensation similar effects are encountered near the leading edge of the brush. In a machine with three coils per slot it is entirely possible for one coil to be under-compensated during commutation, the next properly compensated and the third over-compensated.

It will be noted in Figs. 5 and 6 that the highest current density in the brush face occurs at the same point as the most rapid change of current in the coil undergoing commutation. This fact, together with the increase of contact drop which accompanies this rapid change of current, may cause injurious sparking even when, as in Fig. 6, this condition is encountered at a point underneath the brush and, therefore, is not indicated by visible sparking.

The extremely wide range of fluctuation in local current density, indicated near the central portion of the brush face in Fig. 6-C, may also be a source

of concealed sparking and brush face marking.

It should not be assumed from the foregoing discussion that contact drop is without value in respect to brush performance. Appreciable contact drop, or, in other words, contact resistance, is needed to assist the impedance of the coil in controlling short-circuit current under conditions of imperfect compensation. Reasonable contact resistance probably tends to improve the commutation cycle, preventing overly rapid transfer of current from a segment already under the brush to one just making contact, and also helping force current from a segment about to break contact with the brush into those still making full contact.

Where uniform surface conditions are maintained on the commutator, and the contact resistance of all brushes of like polarity is essentially the same, the fact that contact resistance constitutes the principal resistance in the several parallel paths tends to stabilize current distribution between the brushes and minimize selective action.

● Summary

It is difficult to say what is the most important property in a carbon brush. The characteristic which makes a brush the ideal selection for one application may be of secondary importance to some other property on another machine. For heavy-duty service it seems probable that those characteristics which aid or permit the development and maintenance of a uniform surface film on the commutator are of greatest importance.

The relative importance of individual characteristics, for any particular application, depends upon the unfavorable factors which must be overcome. From the large number of such factors mentioned in the foregoing discussion and the varying influence each may exert on different applications it is easy to understand why the "universal brush" has not yet appeared and probably never will be produced.

A British Estimate of Theatre Television

By *R. HOWARD CRICKS*

TECHNICAL EDITOR, KINEMATOGRAPH WEEKLY, LONDON

CINEMA television is here. A fortnight ago I, in a wildly enthusiastic audience of nearly 2,000, saw in the Marble Arch Pavilion a fight taking place at Harringay Arena; at the newly opened Monseigneur next door, and at the Tatler, Charing Cross Road, packed audiences simultaneously watched the same event.

The Baird equipment at the Pavilion and at the Tatler was, of course, of the projected cathode-ray image type, at the former on a 15-ft. screen and at the latter on a 12 ft. 6 in. screen. From studio transmissions the quality of the picture was inferior to the average newsreel only in being less bright, although the ringside transmission was hardly good enough.

After the fight I dashed next door into the Monseigneur and saw the rest of the transmission there. The Scophony equipment embodies, of course, mechanical scanning, giving an 8-ft. picture. S. Sagall, (head of Scophony) told me earlier in the day that, had time permitted, he could have installed his newest equipment, with improved optical system, giving a 16-ft. picture.

● Extension to Provinces

Following upon the Pavilion show, Isidore Ostrer (president of a theatre chain) spoke of equipping the whole of the G.-B. circuit with large screen receivers, on the assumption that by the time their hundred London theatres are equipped, provincial television services, by means of the coaxial cable, will have become a reality. Even to the London theatres, cable rather than radio transmission might, I suggest, prove advantageous.

What does this advance mean? Is the film, or at any rate the newsreel, doomed? In my opinion, emphatically no! Every news-theatre will, as a matter of course, have to have its television equipment, on which will be shown every important happening, both while it is taking place and, probably, for the benefit of subsequent audiences, a recording of the event also transmitted from the television station, but cut and edited like a newsreel.

● The Projectionist's Viewpoint

But probably there will be only one event a month of sufficient importance to justify depriving ordinary kinema audiences of their film program. For all other events, and for all those family theatres which are never likely to be equipped with television, the newsreel will maintain its hold.

What does television mean to the projectionist? As far as I can see, once the equipment is installed and tuned, nothing more than working his own radio set. Naturally, in the early stages television engineers will be in attendance (a hint to those sound service engineers who have been displaced in recent months), but there seems nothing more in the equipment to necessitate any more attention that the projectionist is capable of.

● Interference Serious Problem

The one thing that does seem likely to cause trouble is interference. Somewhere near Marble Arch is a diathermy plant; eighteen months ago, when Scophony gave a demonstration in British Industries House, it caused trouble, and the same trouble was experienced in tests of the Baird equipment, causing "snowstorms" over the screen. Fortunately there was no trace of it during the actual performance. There seems to be no cure for such interference except at the actual source.

Most gratifying of all is the fact that this country has firmly established its lead in every branch of television. In America, progress has been held up by commercial factors, chief of which is the vicious circle, that without advertisers to sponsor them, programs cannot be transmitted; without programs, receivers cannot be sold; and without receivers, sponsors cannot be obtained. From Germany, too, we have recently heard little of what appeared to be promising early progress.

Postpone Exam. Q. &. A. Series

Publication of the projectionist examination questions, and answers thereto, as offered by the Province of Ontario, Canada, which began in I. P. last month, has been postponed for sixty days in deference to the wishes of several projectionist organizations who have long sought just such a group of questions for their own uses. I. P. is glad to accede to these requests for the indicated period of time.—Ed.

Better Magnet Wire Is Offered by General Electric Co.

Eliminating the need for space-consuming protective coatings in many instances, Formex wire, a new and superior magnet announced by General Electric recently, is insulated with a synthetic resin which is tougher and more flexible than the conventional enamel coatings The new resin is of the polyvinyl acetal type, while ordinary enamel coatings are composed of drying-oil resins. Since Formex wire requires less space for insulation and protection, it gives the designer new opportunities to reduce the size of many products.

Further, electrical properties are as good as those of ordinary enameled wires, and tests show that Formex is considerably higher in resistance to abrasion and to the common treating solvents. When severely twisted and then subjected to a temperature of 125 C. for one hour, ordinary enameled wire cracks but Formex wire is not affected. It withstands the operations of winding, assembly, and varnish impregnation much better than commercially available enameled wire. It can be used to advantage in nearly all applications where enameled wire has been used, and in addition it can be utilized in many applications to replace enamel-cotton, enamel-paper, or other fabric-covered wires where formerly a protective wrapping was necessary.

Changeover Signal Devices

By *HENRY D. BEHR*

SUPERVISOR OF PROJECTION, WILMER & VINCENT THEATRES

GETTING around various projection rooms, one cannot help being impressed by the many methods used to overcome the possibility of missing cue dots on the projected picture. Let us first review briefly the Academy specifications for 35 mm. prints:

"Motor Cue shall be circular opaque marks with transparent outline printed from the negative which has had four consecutive frames punched with a serrated edge die .094 inch in diameter. The center of these holes is to be halfway between the top and second sprocket holes .281 inch from the right-hand edge of the film with heads up and emulsion toward the observer. Following the four frames containing the circular opaque marks there shall be 10 feet, (a total of 172 frames) 12 frames to the beginning of the changeover cue.

"Changeover Cue: Four frames containing circular opaque marks, punched similarly to and of the same dimension and position on the frame as the motor cue. Following the changeover cue marks there shall be 18 frames to the beginning of the runout trailer."

Up to the time that the S. R. P. was adopted as the universal standard, the methods used to cue the picture included the following: Placing tinfoil around the edge of the film; scraping lines or crosses on the emulsion; splice that caused click through sound system; painting film edge with metallic paint to close an electrical circuit; pencil marks that were later removed; coin or metal placed in film near end of the reel; and leaving magazine door open to reveal amount of film still on the reel. Some of these things still are being done.

● Sound Complicates Problem

With the advent of sound pictures it is more than ever necessary to make perfect changeovers in order to prevent marring speech intelligibility and continuity. Blank screens or the showing of the runout trailer are rather the exception than the rule at present. Audiences paying the lowest admission prices will not tolerate this sort of showmanship, as is evidenced by the clamor set up when there is an interruption of the sound or picture for even a few seconds. Good projection requires that someone be at the viewing porthole continuously to observe the picture. This is more than ever necessary since the introduction of Suprex arcs, which are highly sensitive in their operation and often require adjustment to maintain picture quality on the screen.

Many things occur to take the projectionist away from his regularly assigned duties. Usually he is able to effect temporary repairs of sound or projection equipment trouble before the audience voices its displeasure. On other occasions, and particularly while engaged in making repairs, many projectionists have appreciated the need for something that would signal the approach of reel-end cue dots and also provide a signal indicating when it is time to strike arc for following reel.

During recent years many efforts have been made by inventive individuals to develop something to solve this problem. Some of these devices are electrically operated; others function mechanically. Some are quite simple to install and operate; while others are complicated and therefore defeat the purpose for which they were designed.

It should prove interesting to describe briefly some of the devices, each of which will be designated by a letter.

A. Light-Sensitive Device. A light source and a focusing and an adjusting device are contained in a case which is attached to the upper magazine. A light sensitive cell receives the beam of light as directed from the upper case. When the reel of film has been reduced to a predetermined length, the beam of light is no longer interrupted but passes to the cell, which action operates either lights or a bell signal. Thickness of the film, splices, the diameter of the reel hubs and other considerations make it necessary to change the setting on such a device for almost every reel of film.

B. Photoelectric cell method of eliminating visual cues and manual changeovers. The optical assembly collects light from the exciting lamp and projects a line of light onto the film. The p.-e. cell is coupled to the amplifier in the usual way. Current fluctuations cause a voltage drop across a resistor, through a coupling condenser to the grid of the amplified tube. The output of the latter is matched to a frequency recorded on the film through a tuned relay of a momentary-contact type which closes a circuit to an interlocking relay. This closes a circuit to a motor which is geared to a revolving drum in such a manner as to cause the drum to revolve slowly at a predetermined speed. The drum is equipped for closing various circuits at predetermined intervals of time. The revolving drum closes the circuit of a bell or other signal which indicates that the reel is nearing its end and it is time to strike the other arc.

Following this the projector motor circuit is closed by means of a switching arrangement. Operation of relays for control of douser and sound then occurs. The sound control is of the momentary-contact type which functions to close the circuit of the opposite coil, thus cutting out sound from the other machine. The outgoing projector is controlled maually, as the drum does not provide for this operation.

This system would undoubtedly remove the cause of many complaints anent indistinct or missing cue dots; but its multiplicity of circuits and connections make extremely doubtful its adoption for smaller theatres.

C. Cue clips on film reels. A sideplate is used to mount the clips, which are set when the film is rewound at a predetermined point. As the film unwinds each clip is released at the proper time by means of plunger shafts within the spindle which operate mercury switches within the top magazine switch housing. The assembly is mounted on each projector top magazine hangar castings with two set screws.

At a predetermined point the cue is

(*Continued on page* 25)

P. A. McGuire Honored By SMPE Projection Group

P. A. McGuire

Following is the resolution passed unanimously, inscribed on a scroll and signed by the members of the Projection Practice Committee of the S.M.P.E. upon the occasion recently of Mr. P. A. McGuire's resignation from the Committee due to press of other activities:

"WHEREAS, P. A. McGuire was actively instrumental in the formation of the Projection Practice Committee of the Society, and

"WHEREAS, he has vigorously and helpfully contributed to the work of the Committee through the intervening years and, by his thoughtful comments and friendly attitude, has won the respect and personal esteem of the Committee's membership, and

"WHEREAS, he has found it necessary to discontinue his active participation in the work of the Committee,

"NOW, THEREFORE, BE IT

"RESOLVED, That the membership of the Committee hereby express their deep regret at his resignation from the Committee; that they cordially extend to him an invitation to attend the meetings of the Committee whenever he may so desire; and that they convey to him their sincere good wishes for his continued success and future health and happiness."

New Forms for Electrical Data

By *AARON NADELL*

THE highly condensed information included in electrical diagrams and data sheets, always invaluable, has recently been presented in new forms. The complexity of modern equipments has led to the development of improved styles of abbreviated presentation through which, it is expected, drawings will be easier to read. A review of the entire subject is timely.

Diagrams and data sheets have always been planned to convey at least five separate categories of useful information. They indicate: (a) the component parts of an apparatus; (b) the electrical ratings or values of each of those parts, as, for example, the capacitance of a condenser; (c) their *schematic*, or *electrical*, relationship, as where a diagram shows that a certain transformer primary constitutes the plate load of a certain tube; (d) the physical location of the parts in the apparatus assembly; and (e) the physical locations and terminations of the connecting wiring.

The value of this data in trouble-shooting, repair and replacement work is obvious; there remains a practical question as to the methods of presentation that will convey it most efficiently. Four common methods are used, none sufficient in itself. They are: the schematic diagram, the wiring diagram, the tabulation, and the physical marking of the actual apparatus.

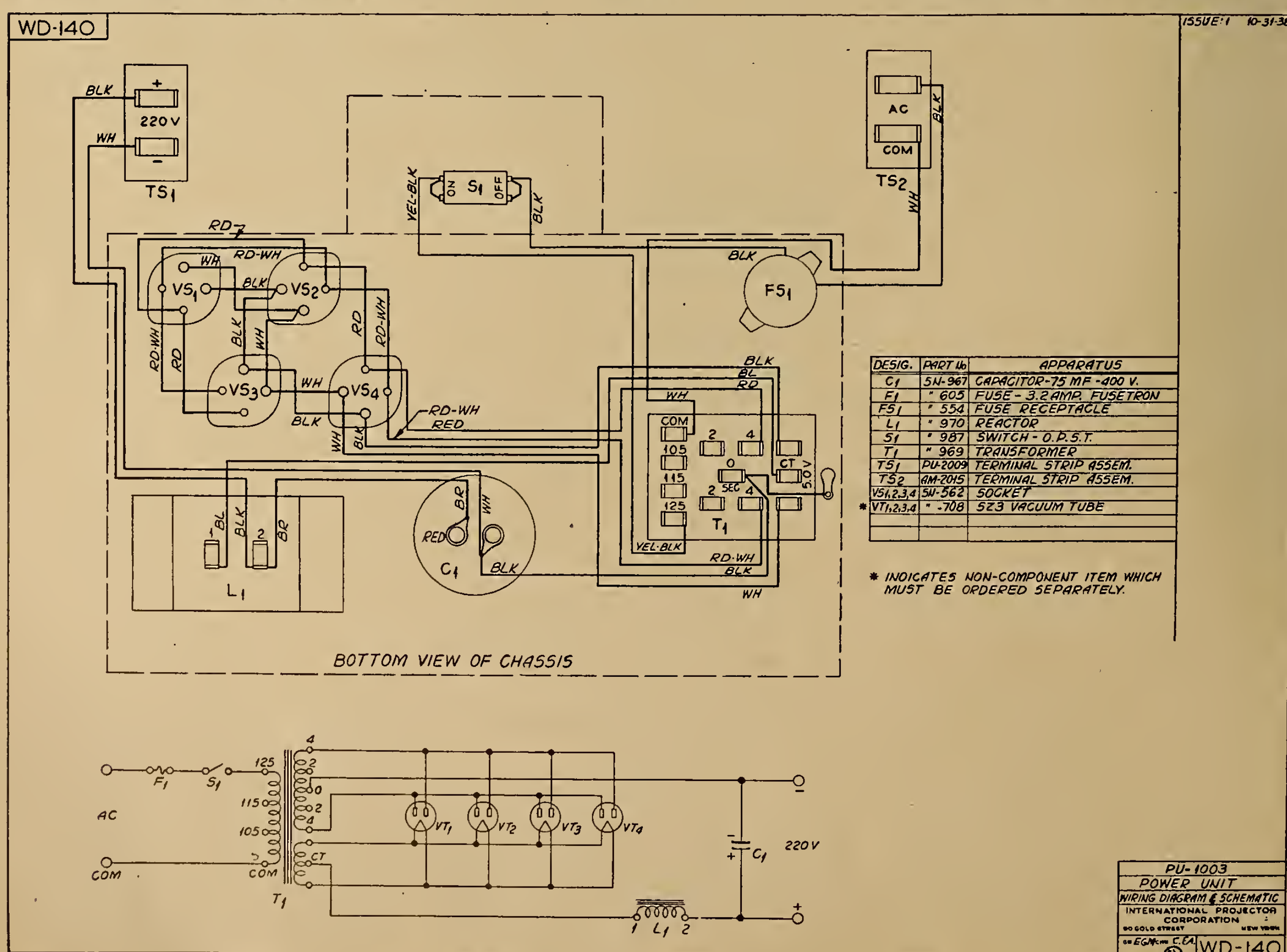
Each of these methods is subject to periodic changes of detail intended to improve its efficiency, reduce its cost, or both; each therefore may be encountered in varying forms in which the information embodied may not be immediately recognized. The simplest presentation, and the one so far least subject to change, is the familiar schematic drawing.

A simple schematic is given at the bottom left of Fig. 1. It has only one unusual feature, namely, the somewhat large number of rectifier tubes here used in parallel. Most readers of I. P. will be able to understand the diagram at a glance; however, it may be traced briefly here for comparison with another diagram of the same apparatus also included in Fig. 1.

The schematic is that of a rectifier receiving a. c. from a power line and delivering 220 volts d. c. The input is at the left, through the fuse F-1 and the switch S-1. The power transformer primary is tapped for 105, 115 or 125 volts, allowing the same apparatus to be used efficiently in different communities.

The lower transformer secondary heats the filaments of the four rectifier tubes. The upper secondary supplies the plates. The action can be considered with reference to VT-1 alone, since the other three tubes are in parallel

FIGURE 1



DESIG.	PART No	APPARATUS
C1	SN-967	CAPACITOR-75 MF -400 V.
F1	" 605	FUSE - 3.2 AMP. FUSETRON
FS1	" 554	FUSE RECEPTACLE
L1	" 970	REACTOR
S1	" 987	SWITCH - O.P.S.T.
T1	" 969	TRANSFORMER
TS1	PU-2009	TERMINAL STRIP ASSEM.
TS2	AM-2015	TERMINAL STRIP ASSEM.
VS1,2,3,4	SN-562	SOCKET
* VT1,2,3,4	" -708	5Z3 VACUUM TUBE

to VT-1 and serve only to add to the total rectified amperage.

Electrons will flow from the filament of VT-1 to whichever of its two plates is positive at any given moment, thence (continuing to trace from negative to positive) through the transformer winding to the center tap of the upper secondary. Then to the right through the negative output line, through the external load, in at the positive output line and left through the choke coil, completing the circuit by returning to VT-1 filament.

The electron stream in the output circuit cannot reverse its direction of flow, since the rectifier tube is a one-way valve; hence, a. c. has been converted to d. c.

The diagram just considered gives, however, only one class of information. It reveals the *electrical* relationship of the different components and the electrical functioning of the circuit. It does not even mention what type of tube must be used for replacement. It does not give the rating of the fuse, F-1. There are no ratings for the choke coil or the condenser to guide replacement when required; and though the output voltage is mentioned, the secondary voltages of the transformer (knowledge that might be useful in checking trouble) have not been included.

Further, there is no indication of the physical placement of the components, which would assist in identifying them in the actual apparatus, and no guide to the physical placement or color coding (if any) of the connecting wires. In short, a great deal of data that might prove extremely valuable in an emergency is omitted.

Some schematics give more detail. Very often they designate tube types, and sometimes carry legends indicating the ratings of other parts. Some few show the color coding of wires. But physical replacement of parts, or of wiring, is almost never included in any but the very simplest schematics. It cannot be included without sacrifice of that *electrical* simplicity which is the schematic's chief value.

● Wiring Diagrams

The greater bulk of Fig. 1 is occupied with the wiring diagram of the same apparatus, in which can be found much of the information not included in the schematic. Here the component parts are outlined in their proper shapes and proportionate sizes, and located exactly as in the apparatus itself. They are identified with their counterparts of the schematic by means of abbreviated designations.

L-1, the filter choke, is drawn at the bottom right; C-1 the condenser at bottom center, and T-1 the power transformer at center left. The four tube sockets are grouped at upper left; the fuse receptacle occupies the upper right-hand corner; while the switch, and the input and output terminal strips are shown at the extreme top of the drawing.

The diagram also shows the exact physical course and location of every connecting wire, *and* the wire color. It identifies the locations of the individual transformer terminals on the transformer block, and shows, further, that the plate secondary center-tap is grounded to the chassis, a fact that might be very important in trouble-shooting but is not shown on the schematic. The filament secondary voltage is also given (5 volts), but the plate secondary voltage is not stated.

Another interesting fact is that the tube sockets are drawn with two large-diameter terminals and two of smaller diameter. As a matter of fact, the former are the filament terminals, but Fig. 1 does not clearly indicate this. For that information those who are not aware of the common practice of making the filament prongs of a tube thicker than the other prongs must go to a book or chart of tube data.

● Tabulations

Most of the apparatus of the wiring drawing is contained within the dashed rectangle which, the legend indicates, shows the bottom view of the chassis; but the terminal strips and switch S-1 are outside that rectangle, therefore they cannot be found by turning the rectifier upside down. Those items must be sought at the front and sides of the unit.

To the right of Fig. 1 is a tabulation containing still other data. Here will be found the rectifier tube designations, the rating of the fuse, and that of the condenser. For replacement purposes, part numbers are given which facilitate the placement of orders therefor. The inclusion of this data in a separate tabulation avoids cluttering up the drawing proper, thus making the wiring detail easier to follow and at the same time enabling the printing of information in larger type.

Figure 2 is another form of tabulation, relating to apparatus of earlier design in which actual wiring information is given in a listing rather than in a drawing. The apparatus covered by Fig. 2 is a terminal block housed in a connection box. The only information required relates what pair of wires go to which set of terminals.

Figure 2 gives this data as efficiently as a drawing could. The central column numbers the terminal pairs, from 1 to 20. Refer to the top line of data. Terminals 1 (read from left to right) receive on the one hand a pair of No. 18 wires in a lead sheath (D. LD.=two wires in lead) from the No. D 88422 control cabinet; from Terminals 38 and 40 of that cabinet.

At Terminals 1 of this connection strip those wires are joined to the leads to Horn No. 1, those leads having their termination at the B-box connection strip, and consisting of two No. 14 braided rubber covered wires. A diagram could not, in this instance, give clearer information, and tabulation is more compact and easier and quicker to read.

● Incidental Notes

Both tabulations and diagrams often carry incidental notes of high value, not to be neglected. For example, Fig. 2 notes that Terminal pair 20 are grounded to the connection box. This note is at the upper right in small type. Two other notes at right center give the drawing numbers of diagrams which convey in drawing form the same information as the tabulation.

It will be seen that both Figs. 1 and 2 carry at their extreme right a column for additional notes. In this particular example that column is not used except for the date of issue. However, suppose that the circuit or parts constants of Fig. 1 are modified in the course of time, perhaps to effect some minor im-

FIGURE 2

WIRE	TERMINATION	TERM DESIG	PAIR NO	TERM DESIG	TERMINATION	WIRE
18 D LD	D 88422 CONTR CAB	TERM 38+40	1	HORN 1	"B" BOX CONN BLOCK	2.14 BRC
18 D LD.	" "	TERM 34+36	2	HORN 2	" " "	2.14 BRC
			3			
			4			
			5			
			6			
18 D LD	46 TYPE AMPLIFIER	MON	7	L-1 + L-2	MONITOR HORN	2.14 BRC
19 O.C. TWIST	BOOTH TELEPHONE	LINE	8	LINE	AUDITORIUM TEL	19 O.C. TWIST
18 D LD	46 TYPE AMPLIFIER	OUT	9	TERM 30+32	D-88422 CONTR CAB	18 D LD
18 D LD	" "	IN	10	TERM 3&4	" " "	18 D LD
			11			
			12			
18 D LD	D-88422 CONTR CAB	TERM 7&8	13	OUT	NS TURNTABLE (WHEN USED)	18 D LD
			14			
			15			
			16			
			17			
			18			
			19			
			20	GND	7D5-A CONTR CAB	1.14 BRC

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NOTE TERM PR NO 20 IS GROUNDED TO A BOX

ASX-5051 2-S-41 SYSTEM WIRING DIAG
ASL-2190 NO 200-A BOX TERM STRIP
ASSOCIATED DRAWINGS:-

NO 300-A BOX TERM STRIP
2-S-46 EQPT WITH
WESTERN ELECTRIC REPRODUCER SETS
WESTERN ELECTRIC SOUND PROJECTOR SYSTEMS
ELECTRICAL RESEARCH PRODUCTS INC NEW YORK
DRAWN BY [illegible] DATE 3-2-29 APP'D
CHECKED BY R.C.B. DATE 12-6-29
SCALE ~ ASL-2191

provement. That modification will be indicated in the right-hand notes column.

In the case of a drawing obtained from a manufacturer *after* shipment of the apparatus, the right-hand note column should always be consulted to determine if any changes have been made in the drawing to which the apparatus, being of older model, does not conform. If this point is not checked, the drawing may prove very seriously misleading.

● Physical Markings

A wiring diagram such as that of Fig. 1 is very often supplemented by reproduction of the same or equivalent markings on the apparatus itself. Thus, transformer terminal numbers may be stamped on the transformer terminal strip. Polarities are usually indicated. Resistors and condensers may carry their ratings in plain type or in color code; both also may be marked with their designation in the particular unit in question, as R-1, C-1, *etc.*

In some equipments individual parts carry, in addition to all this information, their parts numbers corresponding to those given in the tabulation of Fig. 1. These markings, however, often are obscured by heat and dust, and may after some years become illegible; thus the wiring diagram becomes proportionately more valuable in the case of older apparatus.

Details of drawing and tabulation methods change constantly, but in many cases the new procedure can be interpreted easily enough on a common-sense basis. Thus, in the schematic of Fig. 1, VT stands for vacuum tube—a familiar abbreviation long used. VS in the wiring drawing is relatively a new abbreviation, but obviously it means "vacuum (tube) socket". The fuse is designated as F in the schematic, and as FS in the wiring drawing. Small variations of this type are very common. Similarly, in Fig. 1 the tube plates are drawn conventionally as rectangles. In the schematic of Fig. 3 they are given the less usual form of triangles.

● New Diagram Form

Figure 3 also incorporates a very new form of *wiring* diagram and one that promises to become increasingly common in the future.

Refer to Fig. 1. Just above the condenser, C-1, there is a short stretch wherein seven wires run parallel to each other, being a trifle hard to follow. The man tracing some one of those seven wires may become so far confused as to transfer his eye or pencil point to the wrong line. There is comparatively little danger of this in Fig. 1, because the wiring is scanty and simple. But everyone has seen drawings in which the complexity of detail is so great that every line has to be traced two or three times to insure accuracy.

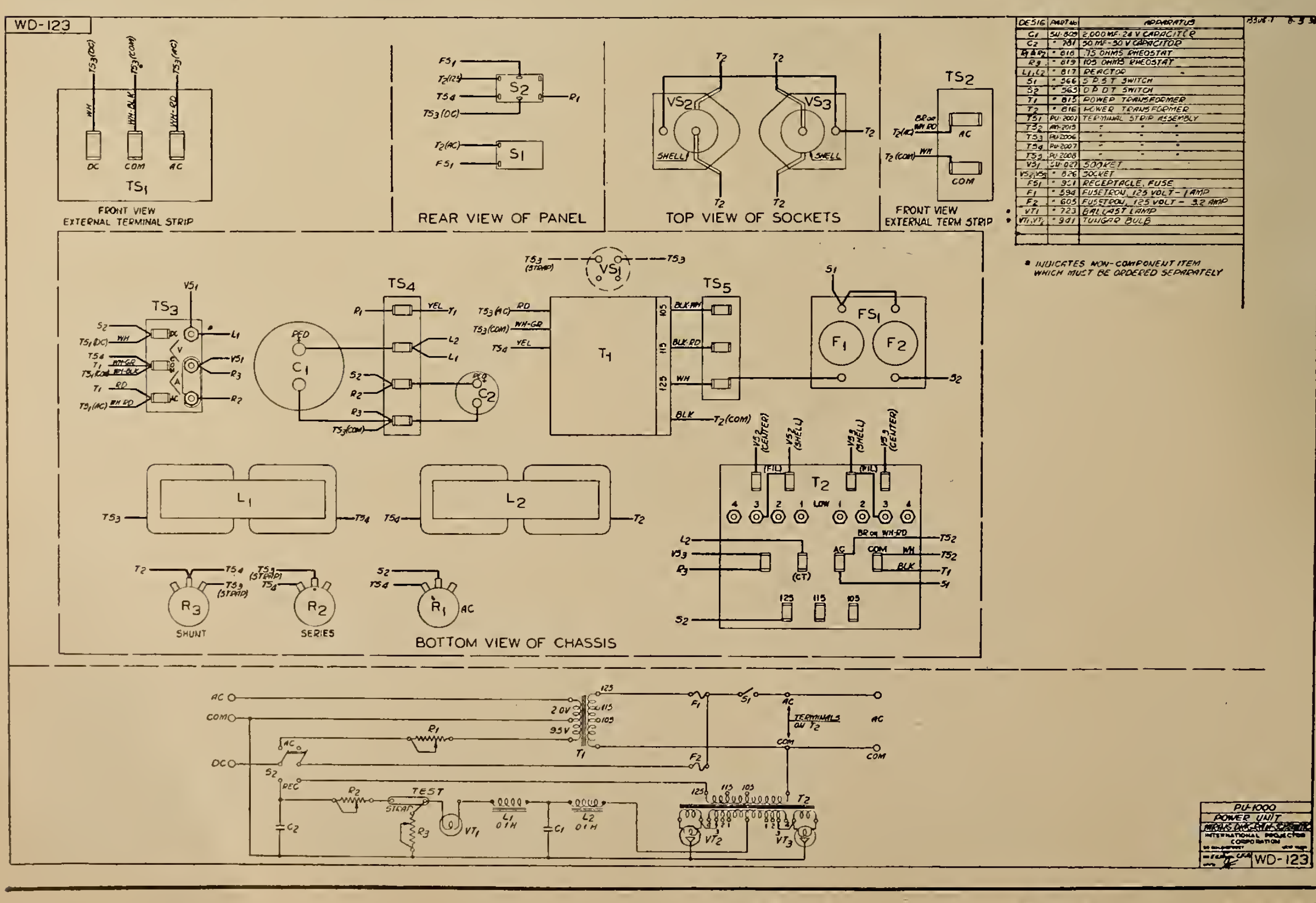
Figure 3 is a wiring diagram that eliminates this risk at some small sacrifice in the amount of information given. It can be read far more easily and quickly. In that diagram the parts are shown in their proper physical placement, just as in Fig. 1. The terminals are correctly shown and marked. Wires are all shown and color-coded. But the paths followed by the wiring are not traced.

Instead, the connections are indicated by printed information. Refer to TS-1, top left of the drawing, and to the left terminal of that strip, marked "DC". To that is connected the stub of a white wire, labelled "TS-3DC". Now refer to TS-3, extreme left center just below TS-1. At the left of TS-3, the second line from the top is a white wire labelled "TS-1DC". This is obviously the other end of the same line, which connects the DC terminal of TS-3 with the d. c. terminal of TS-1. The only thing not shown is the actual path of the connection.

The same method is followed throughout. Thus, refer to L-1, the choke coil just below TS-3. A stub wire (not color-coded) springs from the left of that coil and is marked TS-3. Referring to that terminal strip we see that a wire from L-1 comes in at its upper right-hand terminal.

Or refer to the schematic at the bottom of the drawing. It will be seen

FIGURE 3



that there are two chokes, L-1 and L-2, and that the jumper between them connects to one side of C-1. Now, looking up at the wiring drawing, it will be seen that the two chokes, L-1 and L-2, each carry a stub of wire labelled TS-4. At TS-4, directly above, these two stubs are shown coming into the second terminal from the top, and from that terminal a wire runs left to one side of condenser C-1.

The wiring drawing of Fig. 3, although occupying relatively little space, is entirely clear and easy to follow. If all the connections were drawn in as in Fig. 1, Fig. 3 would have to be made considerably larger or it would be too crowded for quick, practical use. The new method it employs bids to become universal for all complex circuits in the not distant future.

● **Schematic of Fig. 3**

The wiring diagram of Fig. 3 is of course further clarified by reference to the schematic. This deals with an exciter lamp supply circuit equipped with triple provisions. First, there is a rectifier to provide the lamp with direct current. However, a switch makes it possible to substitute 9.5 volts of a. c. temporarily to keep the show going in case of rectifier failure. Finally, there is a "pre-heating" circuit delivering 2 volts a. c. to the exciter lamp not in use. This provides faster changeover, the pre-heated lamp coming up to full illumination more quickly; and also permits the lamp to be used for some testing purposes between reels.

Alternating current enters at the right, and one branch continues left through S-1 and F-1, down through the primary of T-1, and back rightward to the other side of the power line. T-1 has two secondaries, in series. The full-voltage emergency a. c. supply may be traced left from the bottom secondary terminal through R-1 and out through the emergency switch to the output terminal labelled DC; back in at the common and right to the series tap on the transformer secondary.

The common also connects through the exciter lamp with the "pre-heat" output terminal, marked "AC". Switching these outputs is a function of the changeover switch, and those facilities are not shown in this diagram.

Returning to the a. c. input at the extreme right, a branch may be traced downward from the right side of F-1 and left to the emergency switch. When this is down, for rectifier operation, the same line returns to the right to one side of T-2 primary, through that winding and up to the AC input common.

There are three secondaries, of which two light the filaments of the rectifier tubes, VT-2 and VT-3. One filament or the other will at any given moment be negative with reference to its plate, and the electron stream can be traced from that filament to the plate, thence left and up to the common output, through the exciter and in through the d. c. output terminal, down, through the left blade of S-2, to the right through R-2, through the ballast lamp VT-1, through the filter chokes to the center tap of T-2 secondary, and thence through the jumper to filament again.

The reader can readily trace as much or as little of this wiring as he has need for at any time through the abbreviated wire stubs of the aforementioned new style diagram.

Television, Sound Recording Papers To Feature S. M. P. E. Program

DISCUSSIONS of television studio technique and lighting, a new magnetic recorder and its adaptations, a "time telescope," and a review of foreign film markets are a few of the widely varied subjects to be presented at the Spring convention of the Society of Motion Picture Engineers at Hollywood, April 17 to 21, inclusive. Headquarters will be at the Roosevelt Hotel. The television symposium includes papers by representatives of RCA, NBC, CBS, Dumont, Don Lee, and a report by Dr. A. N. Goldsmith, chairman of the SMPE Television Committee.

An important paper on a direct positive system of sound recording, by G. L. Dimmick and A. C. Blaney, of RCA, will be presented, as will a paper on RCA aluminate developers, by J. R. Alburger.

"The Polyrhetor—a 150-Channel Film Reproducer" will be presented by G. T. Stanton, of Erpi, and F. R. Marion and D. V. Water, of W.E., at a demonstration. A discussion of lens making in America will be presented by W. B. Rayton, of the Bausch and Lomb Optical Co. A. A. Mercey, of the United States Film Service of the National Emergency Council, will present a paper on the new frontiers for the documentary film. A light-weight sound recording system will be discussed in a paper by F. L. Hopper, E. C. Menderfeld and R. R. Scoville, of Erpi.

C. M. Mugler, of the Acoustical Engineering Co. will present a paper on "Controlled Sound Reflection." A discussion of a new mobile film recording system will be presented by C. L. Lootens, of Republic Production, and B. Kreuzer, of RCA.

● **Studio Visits Arranged**

Visits to the Paramount and Warner studios will be highlights of the convention. These tours will include visits to the projection background shooting stages, the sound and dubbing departments, production stages, the stages where special effects and miniature work are carried out, property and wardrobe departments, and the laboratories.

The following table lists the railroad fares and Pullman charges from various cities to Hollywood.

City	Fare (round trip)	Pullman (one way)
Washington ...	$132.20	$22.35
Chicago	90.30	16.55
Boston	147.50	23.65
Detroit	106.75	19.20
New York	139.75	22.85
Rochester	124.05	20.50
Cleveland	110.00	19.20
Philadelphia ...	135.50	22.35
Pittsburgh	117.40	19.70

The usual equipment display will be held at Convention headquarters. Prospective exhibitors should contact the Society immediately. The social side of the Convention will include the usual Society banquet, an elaborate program for the entertainment of the ladies, passes to Hollywood theatres, and the usual sports privileges. Many members plan to include a visit to the Golden Gate Exposition in San Francisco on their itineraries.

ANOTHER VICTIM OF OKLAHOMA'S "NON-HAZARDOUS" OCCUPATION

Hollis Haskell, 22-year-old projectionist, was fatally burned by a fire that swept through the Strand Theatre, Phoenix, N. Y., recently, and also burned severely a high-school student who was in the room at the time. The latter jumped from a window to the floor 10 feet below, but later returned to attempt a rescue of his projectionist friend. Haskell succumbed to second- and third-degree burns within four hours after the fire. He never recovered consciousness after the first blast of flame and gases swept through the projection room.

Oklahoma State Supreme Court only recently affirmed an earlier decision holding projection work to be a "non-hazardous" occupation and one that does not entitle projectionists to compensation in the event of injury by fire or otherwise while handling film.

EXCHANGE SAFETY RECORD

With an estimated 27,000 miles of motion picture film being handled daily in the exchanges owned by members of the Motion Picture Producers and Distributors of America (Hays office), there have been only 11 film fires in these exchanges in the 13-year period from 1926 to 1939. Aggregate money damage was only $4,477.50.

CANADA BARS 35 MM. PORTABLES

Standard rental agreement of the Film Boards of Trade in Canada has stopped the further use of 35 mm. pictures in halls by prohibiting the booking of standard films except for theatres having permanently installed projection machines and sound systems. This means the termination of standard film exhibition with portable projection equipment.

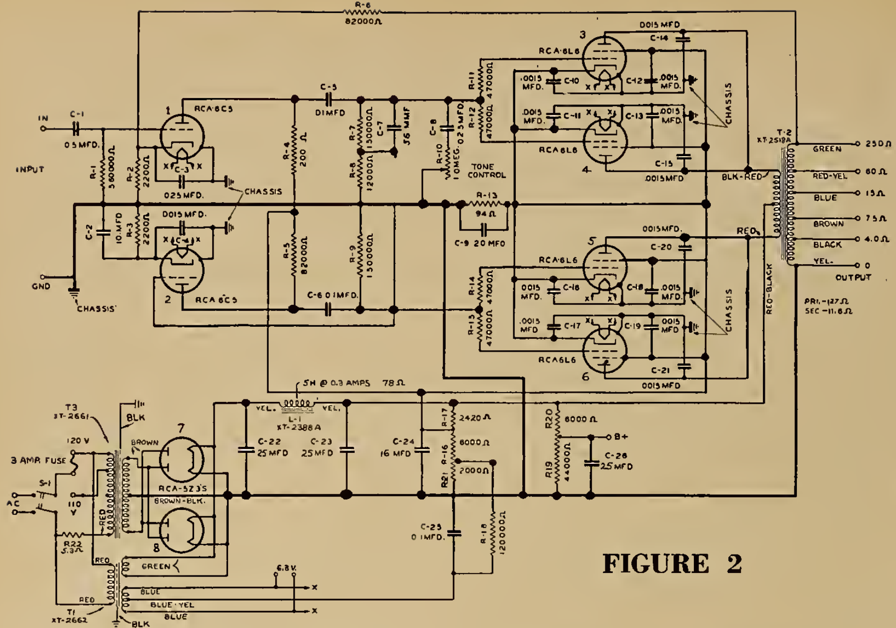


FIGURE 2

Sixth Subscription Contest Diagram

PARTICIPANTS in I. P.'s Diagram Contest continue to amaze by their utter lack of consistency. From a record high of 28 successful entries on the January issue circuit the boys slumped so badly as to provide only two winners, out of a total of more than 80 contestants, on the circuit offered in the February issue. The only winners this month are C. E. Mervine of Pottsville, Penna., and Francis L. Hill, of St. Petersburg, Fla.—both of whom, incidentally, are officials of I. A. local unions.

Here is the lineup of the errors appearing in the February diagram (Fig. 1):

1. Jumper added from center tap of F secondary to the center tap of H secondary.
2. Ground removed on lower end microphone transformer secondary.
3. Cathode bias resistor removed on first tube.
4. Jumper removed between .015- and .0005-mfd. condensers.
5. Jumper added between tops of dual ½-mfd. condensers in first tube plate and screen circuits.
6. Jumper added (without connection dots) from the grid of lower output tube to the plate line.

Now, just what should have proven so very tough about this diagram it is difficult to say. The circuit is that of a De Vry amplifier for 35 mm. reproduction, very few of which have been used in the theatre field. It was introduced about five years ago, which means that it does not reflect the use of such advanced engineering as might offer much trouble to projectionists who know their circuits.

Grid Connections Mislead

There would undoubtedly have been many more winners were it not for the fact that most contestants were misled by the grid connections of the second tube, the general assumption being that those connections had been changed from the conventional grid arrangements. The use of positive control grid and connection of signal to the screen grid, as shown in Fig. 1, is sometimes resorted to in order to get higher gain.

Contestants seem to be about equally divided on the question of whether the incorrect diagram should be reprinted and the errors therein summarized, or the correct diagram should be reproduced. The latter course would have the very definite advantage of providing I. P. readers with a series of diagrams relating to many and diverse types of amplifier circuits.

The current Contest diagram (Fig. 2) offers an entirely conventional circuit. As usual, the more important parts of the circuit have been redrawn, thus making futile any attempt to check the errors through possible faulty inking. Only subscribers to I. P. are eligible for the award, which continues to be a free subscription to I. P. for one year.

All replies must reach I. P. not later than April 20 in order to receive consideration. It is not necessary to enclose a copy of the diagram, either the original or a copy thereof. A list of the errors found will suffice.

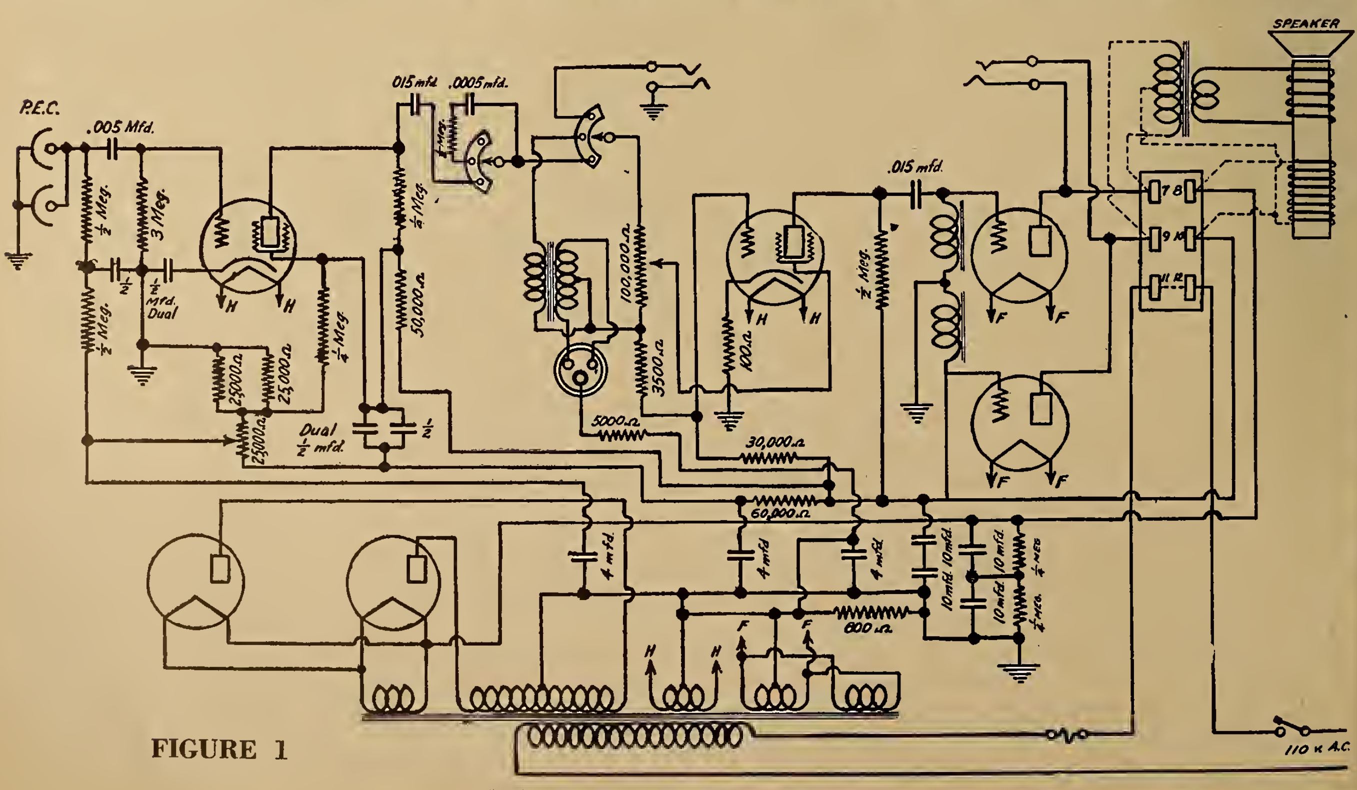


FIGURE 1

Addendum to Cooperative Work by Projectionist and Serviceman

More Gleanings from Altec Service Corp. Files Anent Field Teamwork

By *LEROY CHADBOURNE*

CRIES of: "Encore!" Well, I asked for it, and I got it! Last month, I wrote an article made out of "true life stories" I dug up out of the Altec files,—true life stories about how the team of *projectionist plus serviceman* could like a problem in a spirit of hearty cooperation, when neither one could lick it alone half so easily.

Then, at the tail-end of the story I said "Would you like to hear more stories along this line?" and gosh! your letters and comments told me in no uncertain terms to "do an Oliver Twist" —and go back to the Altec files for another helping. So here's lookin' at ya!

● He Unearthed—A Crank!

At 6:56 P.M. on a recent Tuesday afternoon, the Colonial Theatre at Phoenixville, Pa., put in a call for the Altec inspector. The motor driving No. 2 machine wouldn't "pick up" to normal speed. Because it wasn't practicable for the inspector to talk to the projectionist, he couldn't learn any more details or offer possible methods of correction over the 'phone. So he told the manager he would start immediately for the theatre.

Arriving at the theatre, the inspector thought to himself: "Well the show'll be running on one machine, with the historical 'One Minute Please' being flashed on the screen while the single good machine is being threaded for the next reel!"

Imagine his surprise when, on arriving in the projection room, he found the show *operating normally on two machines!* How come? The reason for this unexpected serenity of affairs was this:

During the time the inspector was racing to the theatre, the projectionist put on his thinking cap in a big way. He reasoned like this: "If the motor hasn't enough power to bring the machine up to normal speed, how could *I* get the motor up to normal speed?"

Now I'll detour just a second for the benefit of you young fellows who don't remember the old days of the motion pictures — yeah, they were called "flickers" then, and they used acetylene lamps and, so help me Hannah, a hand crank to operate the projector!

Well (shades of the old days when they still put a buggy-whip socket on the old automobiles!) it's a fact that present-day projectors *still* are equipped with facilities for inserting an old-fashioned hand crank*. So our hero (the projectionist) has the following big-time brain-wave:

"I remember seeing an old hand-crank somewhere around here!" He rummaged around among a lot of assorted junk that had just never been thrown out. Lo and behold—he found the crank! He stuck the crank in the place provided for it in the projector, cranked like hell and brought the machine up to normal speed.

Then came the big surprise. He figured he would have to continue cranking the machine, but was delighted to find that once the machine was boosted up to normal speed, the motor was able to carry on and hold to the normal pace. So, each time it was necessary to run the No. 2 machine, the projectionist brought the motor up to running speed with a half-dozen revolutions of the crank—and the show continued uninterruptedly, the audience not being aware of anything being different.

So you see what I mean when I said "Imagine the Altec inspector's surprise!" Well, there's no substitute for experience and mental alertness and the projectionist *thought* of using a hand-crank—and then dug it up out of the mothballs!

The inspector traced the trouble in the motor to a defective transformer in the 708-A motor control cabinet. A nearby Altec emergency stock point was contacted, and a replacement for the transformer was shipped to the theatre pronto.

● A 'Short'—Not A Crank

Here's another case of exactly the same trouble. The drive motor just wouldn't pick up to normal speed. So the Rialto Theatre at Tonkawa, Oklahoma put in a call for Altec. But in the meantime, the projectionist asked himself, must my show limp along on one machine for several reels? Not liking the idea worth a damn, the projectionist decided to go on a still-hunt on his own.

When the motor first started to act up, he quickly checked over the motor proper. He couldn't find anything wrong. So where do we go from here? Answer: obviously the 708-A motor control cabinet.

In looking over the various components of that intricate piece of apparatus, he reasoned that the motor would come up to normal speed all by itself—if he momentarily short-circuited resistors R-6 and R-7! As soon as the motor came up to its standard 1200 r.p.m., he found he could remove the short-circuit across R-6 and R-7 and the motor would continue merrily to turn the machine at its standard speed!

So he kept the show going on both machines this way, until the Altec man got to the theatre and cleared the trouble.

Here's the technical dope on what the projectionist did when he short-circuited resistors R-6 and R-7: These two resistors are in the grid bias circuit

(*Continued on page 24*)

*ED.'s NOTE: This ingenious method of keeping the show going is possibly only with current Regular and Super-Simplex projectors; and forthcoming models of the latter will not permit this procedure. It is entirely possible to utilize this method because the motor, once up to speed, ran along on its own.

Micro-Photographs of Projector Parts To Appear in I. P.

BEGINNING with the next issue, I. P. in cooperation with International Projector Corp., will publish a series of micro-photographs of various components of motion picture projectors, with special emphasis upon those defects which contribute materially to faulty operation. The pictures will be shot on a Zeiss toolmaker's microscope having a photographic attachment permitting an enlargement of 42 diameters.

Projectionists in the field who desire to submit particularly glaring examples of worn or faulty projector components—sprockets, gears, etc.—are cordially invited to do so. Because of space limitations and other considerations, I. P. cannot guarantee to reproduce every such part submitted, although every effort will be made to make the series of pictures as inclusive as possible.

Ohm's Law and its Application to Some Projection Problems

By *JOHN H. HERTNER*

PRESIDENT, THE HERTNER ELECTRIC COMPANY

ELECTRICAL resistance plays so important a part in the daily work of the projectionist that a thoroughly practical understanding of Ohm's Law is a fundamental requisite for his work. The algebraic forms:

$$I = \frac{E}{R}, \quad E = IR \text{ and } R = \frac{E}{I}$$

are probably quite familiar to everyone. We can substitute values at hand for any two of the three quantities considered and find the third; but does this imply that the real meaning and application are clear and that when confronted by a problem involving current volts and ohms the Law can be readily employed in its solution?

The writer has had many years of experience in the motion picture field. It has now been 24 years since the appearance of the Transverter, but we still receive letters from projectionists which show plainly that they have missed the point of just what it all means.

Prime Considerations

In any carbon arc, no matter of what kind, the main considerations are amount of current, voltage across the arc, and length of arc. These are all interdependent, yet if two of the three are fixed, it does not mean that the third will always assume a definite value. This is true largely because, while we have done nothing to change the apparent length, the flow of the arc may have assumed a new path with a different resistance.

This apparent discrepancy seems to bedevil the Suprex arc more than some of the older types. Horizontal operation, together with the very special construction and materials of the carbons, probably explain this. Lengthening the arc increases the voltage across the arc or decreases the amperes, or does a little of each—usually, but not necessarily.

Quite often when operating an arc on a ballast of fixed resistance and with a supplied voltage so steady that there was no discernable variation, the current is found to vary, sometimes abruptly and sometimes periodically, especially if the current strength is not suited to the size of carbon used. It is this condition that is mystifying and leads to a suspicion as to the infallibility of Ohm's Law.

The Suprex arc today is operated either off a generating source of constant voltage with a ballast resistance, or off a source having what is known as a drooping characteristic, that is, as the demand for current increases the voltage produced by the generating device decreases. With the drooping characteristic it is possible to operate without the use of ballast, but two arcs cannot be burned simultaneously from the same generating source.

With the other plan, using a constant voltage source, this voltage is held somewhat higher than that required for the arc, the difference being consumed in the ballast. In this manner two or more appliances can be used at one time, and the arc in each will burn independent of all the others. The Suprex arc is particularly adapted to this sort of operation because the ballast resistance required is small, being on the order of 6 to 10 volts in place of the 25 to 30 usually employed with the higher voltage arcs.

Supposing, then, an arc is burning on a constant voltage source with a ballast in series. The voltmeter, if steady, will show that the generator output is constant. If the voltage should change, the voltmeter would tell how much, just when, and for how long.

The ballast, adjusted with a certain position of the handle or with a certain combination of short-circuiting clips, has a very definite resistance, which means that with a given current in amperes the voltage across the ballast can be only one definite thing. The one thing that cannot be controlled is the *resistance of the arc itself.*

Unwarranted Criticism

All of which leads us to an important conclusion.

If the voltage remains constant as shown by the meter across the generating source while the current is fluctuating, the current source cannot be blamed for these fluctuations.

Suspicion will next fall on the ballast. Herein is always present a possibility of poor or loose connections, which are really the only cause of rheostat trouble. To detect such trouble is not so easy, since the voltmeter across the rheostat or ballast will keep step with the fluctuations of amperes in the arc because our old friend Ohm's Law is in full force and

$$R = \frac{E}{I}$$

If the resistance remains constant, as it should, and the current changes, the

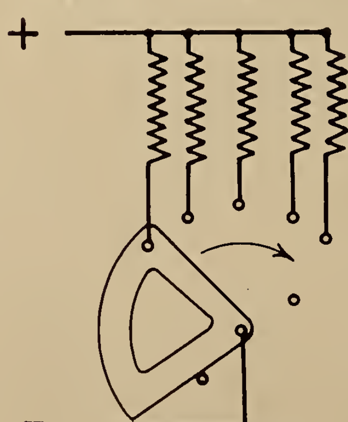


FIGURE 1
Multiple progressive

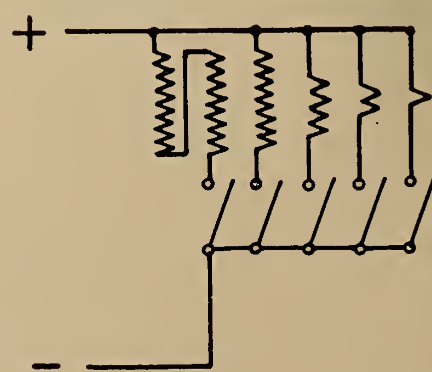


FIGURE 2
Multiple selective

voltage drop across the ballast will change up or down in proportion to the current change.

One way of detecting rheostat trouble is to look for hot spots. The writer has found rheostat installations in which the series ribbon type is used, and where the resistance value is adjusted by the cutting out or in of clips on the front, where the clips had not been tightened and were so hot as to burn the hand.

Another way of checking ballast is to put a voltmeter across its terminals and watch it in conjunction with an ammeter. If at any time a fluctuation of the voltmeter can be detected when the ammeter is steady, the trouble is definitely located in the ballast.

Ballast resistances, of both the series and the multiple type, are so constructed today that very fine gradations of current values are possible and usually no adjustment of the field regulator is required. These finer gradations are accomplished in both the series and the multiple types by using sections of various resistance values and then arranging that these are inserted *selectively* rather than *progressively*.

To dig into this topic a little deeper: the multiple type of resistance generally consists of wire coils, cast grids or, in some cases, ribbon, the one end of each being attached to one rheostat lead, while the other ends are brought to either a series of contacts which are swept by an arm (Fig. 1) or to independent switches (Fig. 2) the arm or switch being then connected with the lead of the rheostat.

If the arm be used, the sections of resistance can be cut out or in *progressively only*. There is no choice. If the independent switches be used, the sections can be cut in or out *selectively*, any one being operable at will without disturbing the others.

Similarly with the series type of resistance where all the sections carry the whole current, an arm (Fig. 3) can be arranged to cut the sections in or out progressively, or clips (Fig. 4) can be used to "short out" any section selectively.

As an illustration, suppose there are five sections of these which have values of 1, 2, 4, 8, and 16 ohms and all have the same current capacity, the total resistance series-type being 31 ohms. No. 1 may be shorted (Fig. 4) leaving the resistance 30; No. 2 may be shorted, leaving a balance of 29; Nos. 1 and 2 give 28; No. 4 gives 27; Nos. 1 and 4 give 26; Nos. 2 and 4 give 25, and so on in 1-ohm steps down to a final value of 1 ohm. However, if all of these steps were made of the same value, approximately 6 ohms each, we would be able to get only 30—, 24—, 18—, 12—, and 6-ohm steps.

In the multiple type the same plan brings the same results (Fig. 2). A shift in the position of the field regulator should no longer be necessary, except possibly in going from an average to a very dense film. The temporary adjustment is possibly more easily accomplished in this way.

● Elements of Confusion

There are always a number of unlooked for possibilities that tend to confuse one, and sometimes put unmerited blame on a unit of equipment. It is not unusual to have a steady generator voltage but an unsteady arc due to imperfect contacts in the ballast rheostat or in the wiring. A recent case of this kind was blamed first on the generator, then on the rheostat, but the trouble was finally found in the wiring. The actual fault was hidden in the conduit imbedded in concrete where it could not readily be discovered, and it was located only after all combinations of lamps, wiring and ballast had been tested. The fault always accompanied the combination which included that particular part of the wiring which proved defective. This wiring had to be pulled and repaired.

Frequently it is found that the clips on the series-type ballast now widely used were changed but not tightened. Heating and, in some cases, oxidation ensued with consequent fluctuation of the arc.

Shortly after the introduction of the Suprex arc, where two lamps are burned alternately, and on changeover simultaneously, off the same generator, each lamp with its ballast, complaints were made that on throwing in the second lamp the light on the first lamp would dip. Investigation showed that this statement was true. The voltmeter across the generator showed no drop with the burning of the second lamp; in fact sometimes an actual slight rise in voltage would ensue indicating overcompounding.

Further investigation showed that in most instances the distance from the projectors to the generator was rather long, and the wire, while in accordance with Underwriters' requirements, had enough resistance drop to account for the trouble. Probably the first thing to occur to most projectionists confronted by this condition would be to increase the size of the wire and its consequent carrying capacity so as to minimize this effect.

A much better solution was worked out. By running two independent lines to the lamps the trouble was entirely eliminated; the amount of copper used was no more than in the original installation. The line drop caused by the current in either lamp was then confined to that lamp, and this drop could then be considered a part of of the rheostat drop and had no distorting effect.

N. Y. LICENSE BILL HAS FULL CREW, APPRENTICE ANGLES

Bill which has advanced to a third reading in N. Y. State Legislature, and affecting only N. Y. City, not only establishes a licensing system for projectionists and minimum training requirements for apprentices, but makes it a misdemeanor to employ, or permit to operate, an unlicensed man in any theatre or place of public admission where motion pictures are exhibited, with or without charge for admittance.

Measure also asks employment of not less than two licensed projectionists where there is more than one projecting machine on the premises.

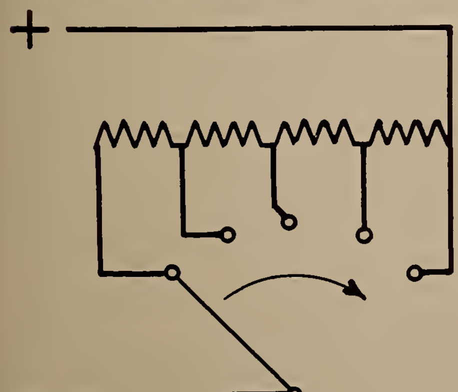


FIGURE 3
Series progressive

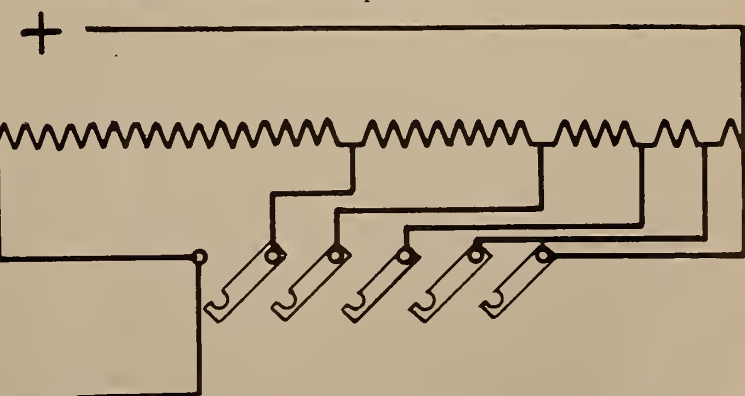


FIGURE 4
Series selective

NEW BACKGROUND PROCESS PROJECTOR†

By *G. H. WORRALL*

MITCHELL CAMERA CORPORATION, HOLLYWOOD, CALIFORNIA

A NEW type of background projection apparatus has been developed using the Mitchell sound or eccentric movement identical with the one used in the latest cameras, except for some minor details.

The principal objectives in designing this equipment were freedom from maintenance and elimination of excessive noise. Freedom from maintenance is accomplished by elimination of heating of the mechanism and by use of the eccentric movement which has relatively little wear. The noise is reduced by the eccentric movement, since the accelerations are low due to the use of eccentrics instead of cams.

It has been found from experience that it is necessary, in order to have steady background projection, to have pilot-pins that give positive registration using the same holes for projection as used in exposing the original film. Thus the present projectors in most Hollywood movie studios are built around a camera movement having pilot-pins.

The film in this movement is guided through a narrow channel composed of very light steel-plates which reciprocate in a direction parallel to the lens axis in order to push the film on and off the pilot-pins. In order to reduce the inertia it is necessary to make the plates as light as possible; consequently the spill light that strikes the plates causes them to warp and, in time, to require considerable maintenance.

The new projector using the eccentric movement similar to the Mitchell camera movement has a fixed film-race, with the pull-down claws and pilot-pins entering the film in this fixed race and moving it in the direction of travel only, so that a heavier and more rigid construction may be used around the aperture. The movement has also been modified to accommodate a very large angle of light.

The regular pilot-pin bearings have been offset downward so that they do not interrupt any beam of light, and at the same time, the bearings themselves are removed from the heat so that the pins will not freeze due to oil evaporating from the bearings if subjected to excessive heat.

● Filling the Aperture

The present method of illuminating the aperture in order to get a reasonably uniform light on the film is to cover an area of several inches in diameter on the front of the projector and to use only the center portion of this area. This method necessarily throws considerable heat on the projector with a corresponding rise in temperature, sufficient at times to cause the mechanism to freeze.

To overcome this difficulty a radiator consisting of a series of fins extending from the edge of the usable light-beam, outward in all directions for approximately 1½ inches, was placed between the lamp and the main body of the projector. This radiator defines the light that falls upon the aperture and prevents any spill light from falling upon the main body of the projector. The radiator is insulated from the main body of the projector by means of a thin disc of relatively poor conducting material so that a rather steep gradient is maintained between the radiator and projector.

The difference of temperature is of the order of 100°F across approximately ⅛ inch of non-conducting material. Thus the difficulties caused by excessive heating of the mechanism are removed.

The projector is equipped with an interlock motor and synchronizing device for setting the shutter in phase with the camera shutter after interlock has been established.

Probably the most interesting question in connection with a projector of this type is: "Is the picture steady?" In answering this it can be pointed out that the projector has been tested in several of the major studios both visually and photographically, and has proved itself capable of projecting extremely steady pictures. The machine is at present being used by Technicolor in some experimental work to demonstrate the possibility of process work in connection with their system of color photography, and has proved quite satisfactory for such use.

†J. Soc. Mot. Pict. Eng., XXXII (April, 1939).

Major N. Y. Strike Looms as I. A. Demands Exchanges Deny Film to Non-I. A. Theatres; Legal Angles

A STRIKE of major proportions carrying with it the threat to tie up the entire theatre field in N. Y. City loomed as this issue of I. P. went to press as a result of an unprecedented strike order issued by I. A. Local 306 against projection rooms in the home offices and the exchanges of all major film companies. L. 306 seeks to compel the distributors not to deliver film to the approximately 75 non-306 theatres in N. Y. City against which the union has waged an unsuccessful organizing drive for many years.

Immediately following issuance of the L. 306 strike order, its sister I. A. Local 52-B, which includes all exchange workers, announced that its members would not cross the L. 306 picket lines. This move threatens to paralyze film distribution to all N. Y. theatres. It is considered highly probable that other I. A. locals in the N. Y. area—including 54, studio mechanics; 702, lab. workers; and 644, cameramen—would progressively lend support to the strike.

This move of Local 306, generally regarded as having been planned in its entirety by the I. A. General Office, is the first attempt by the International to utilize its industry-wide organized units to force the unionization of non-I. A. theatres. It is understood that N. Y. City was selected as the proving ground for this experiment because if its extreme vulnerability as the first line in the industry's distribution system, in addition to providing an admirable test case because of the existence of theatre contracts with a union other than I. A.

● The Distributor Stand

This strike is regarded in legal circles as of questionable legality for a number of reasons. First, there is the distributor contention that compliance with the demands of L. 306 would place the film companies in violation of contracts to deliver film already bought by the independent theatres, against which the strike is directed.

It was on this ground that the trustee for R.K.O. (in receivership and therefore subject to Federal Court jurisdiction) petitioned Federal Judge Bondy for instructions as to what action to take in the situation. The petition said failure to deliver films might bring suits for breach of contract; and it asked the court to advise whether the demand of L. 306 was legal. The court was also requested, in the event it held the union's demand illegal, to authorize the trustee to bring suit for an injunction against the union on the ground of coercion.

Judge Bondy advised the company to endeavor to carry out its contracts while seeking to negotiate a settlement with the union. At the same time, however, the court indicated that the company was free to seek an injunction against any act it deemed unlawful.

Counsel for the R.K.O. trustee told the

Pre-Show Print Inspection Urged By Canadian Exhib. Unit

Attention of the members of the Independent Theatres Assoc. of Toronto, Canada, has been called by its leaders to the fact that under the standard license agreement the exhibitor is held responsible for damage to film by fire, but there is one way in which the responsibility for such fires can be shifted to the distributor.

The Assoc. contends most theatre fires are caused by film tearing and clogging the machine long enough for the heat of the carbon to ignite the film, and therefore "most fires of this origin are caused by the faulty condition in which films are delivered to subsequent-run theatres," and that "revivals are in notably bad condition."

Exhibitors are advised to "have your projectionist examine all film prior to showing, make out a report on the condition of any damaged film" and to "mail this report to the exchange before show time." It is stressed that "this report constitutes evidence"; and "should a fire result from the condition of the film, the liability can be traced to and fixed on the distributor."

court that yielding to the union's demand might place the company in the position of having violated the anti-trust laws in cooperation with the union. Counsel for L. 306 denied there was any such danger. Lawyers freely predict the issuance of injunctions against the union. In some quarters, however, it is held that distributors are protected against exhibitor suits for non-performance by the "causes beyond our control" clauses in film contracts.

Other Legal Considerations

Another interesting angle of the situation is the existence of contracts between the independent theatres involved and a non-I. A. affiliate (Empire State Union). Lawyers hold that the Empire group has been duly chartered by N. Y. State, that its contracts are wholly valid, that its members have a right to work no less than do members of L. 306, and that under existing labor laws Empire certainly is the authorized bargaining agent for these men.

Thus, even should the distributors accede to the demands of L. 306, which action is extremely doubtful, the theatre owners could hardly escape a suit by Empire State Union on non-performance of contract. Then, too, there is the possibility of a suit by the exhibitors against the I. A. for damages stemming from the action by the latter.

It is admitted by all parties concerned that I. A. exchange workers and projectionists cannot be forced to work, but this merely gives rise to another question as to what course would be pursued by the distributors when confronted by an indefinite closing of their exchanges. Of course, I. A. could refuse to let its theatre projectionists handle film produced by non-I. A. exchange workers.

Move Constitutes Precedent

This strike action by the I. A. certainly constitutes some sort of precedent in the annals of American industrial relations. It is a not uncommon move for a labor union to refuse to handle the product of non-union labor, whether in transport or for some additional work necessary to turn out a finished article. Such non-union products are commonly known in labor circles as "hot stuff." The Teamsters International has extensively used this means to bar the transportation of products originating in non-union sources. The idea has also been applied extensively in quarrels between A. F. of L. and C.I.O. units, and there are even cases on record where A. F. of L. units have used the device in jurisdictional squabbles among themselves

The current N. Y. City stand of I. A., however, is unique in that the product at issue, motion picture film, is not only handled from raw stock to completed print by

(Continued on next page)

NEW RCA 3-WAY MIKE

A microphone, known as Model 77-C, which combines in its compact, streamlined case all the characteristics of three different type microphones, making it ideal for radio, movie or any public address use, is announced by RCA. A handy switch at the base makes the new unit uni-directional bi-directional or non-directional instantly, and permits almost, limitless applications.

With the control switch in the uni-directional position, the instrument picks up only sounds reaching the front, or live side—turning a deaf ear to those emanating from any other angle. As a bi-directional microphone, it performs like an ordinary velocity instrument, being responsive on only two sides. In the third position, the control switch permits sounds coming from any angle to be picked up.

N. Y. C. STRIKE SITUATION

(*Continued from preceding page*)

members of the A. F. of L. but even by the members of only one affiliate thereof, and that the I. A. itself. This poses the very interesting question as to the ability of a union to determine not only the labor conditions under which a product may be manufactured but also to retain the decisive voice as to its ultimate disposition and consumption. Lawyers hold that under these circumstances the N. Y. City situation inevitably must tangle with the commerce laws of the U. S.

These, and possibly other, questions all must be answered before the N. Y. City situation is settled—provided no party to the matter gives way pending final adjudication. At the moment, however, the issue is joined, and it is one fraught with immense significance to the I. A., to the distributors, to exhibitors, and to non-I. A. unions.—J. J. F

Oil-Parafine Treatment For Mirrors Frowned Upon

From J. A. Campbell of Miami, Florida, comes the following note anent the refurbishing of mirror reflectors:

"Have recently run across a brother projectionist who works on Suprex lamps, the reflectors for which are in need of replacement or resilvering. He tried cleaning them in several different ways; finally one day he deliberately rubbed them with an oily rag.

"Liking the result of the oil treatment, he cleaned them again, and after getting them hot in the machine, took a block of parafine and rubbed it over the surface. The parafine spreads freely on the hot glass, after which the projectionist gives it a high polish with a clean rag, removing the surplus oil.

"The results of this treatment are apparently good. Could I. P. give us a report on this procedure—that is, let us know just what happens under these circumstances. Or, are we just kidding ourselves?"

● Foresee Oil Trouble

To which is made the appended reply by Dr. W. B. Rayton of Bausch & Lomb Optical Co:

"The process described does not impress us as one likely to make any permanent improvement in the performance of the reflector. Certainly, if the reflector is in need of resilvering, no treatment given the front surface of it can take the place of the required resilvering, for I assume he is using a standard mirror with the silver on the back.

"The application of any organic oil to the front surface of a mirror exposed to the heat of a motion picture lamphouse would seem to me to promise considerable trouble as a result of the

NEW FRENCH STEREO FILM

A new process of third dimensional pictures, said to differ entirely from all previous attempts to obtain films in relief, has been invented by M. Barraud, of Paris, France. The system is called Neo-Relief. M. Barraud claims that Neo-Relief necessitates no modification in either projector or screen, nor does it require the wearing of special spectacles by the spectators. It does require a change in camera, however. An early demonstration is promised.

evaporation of most of the oil, leaving some sort of a gummy residue on the surface that would again reduce the efficiency of the mirror.

"One condition that seems likely to be improved by such a treatment would be one in which the front surface of the mirror is badly scratched or pitted, causing a considerable loss of light due to diffuse reflection. An oil that filled the scratches and pits would bring about an improvement, but I would not expect it to last for any length of time."

Maine 'Safety' Shutter Bill Draws Exhibitor, I. A. Fire

A Maine legislative bill to require installation of a "safety" shutter between the inflammable film and the light on theatre motion picture projectors to prevent fires was termed by opponents at a hearing "an attempt to legislate a costly, untried and unnecessary device into Maine theatres." Theatre owners, told legislators that the device had not been offered to theatre owners in this region.

Proponents of the bill, said the device would stop instantly hot light rays in a projector when breaks or other stoppages occurred, doing away with fire hazards. R. W. Gustin and B. J. Dorsky, both of the Bangor I. A. Union, opposed the installation of the device because it would not "banish the flame-flash on the screen causing panic, nor materially aid in cutting down hazards of operation."

CENTURY-ERPI S. A. DEAL

Century Electric Co., of St. Louis, Mo., has completed arrangements with Erpi whereby the latter firm will act as exclusive distributor for Century generators in Mexico, Central America, West Indies and certain So. American countries.

U. S. THEATRES TOTAL 15,701

Operating theatres in the U. S. on Jan. 1 last totaled 15,701, representing a drop of 550 active theatres in the preceding 12 months, according to a nation-wide survey completed recently by *Film Daily*. Total number of seats is 9,996,830, as compared with 9,855,325 in the 16,251 active houses on Jan. 1, 1938. Figures indicate a high mortality among the smaller theatres.

U. S. theatres closed as of Jan. 1 numbered 2,128, with an aggregate seating capacity of 826,910. Comparable figures for Jan. 1, 1938 were 1,931 and 801,981.

SIMPLEX-ERPI FOREIGN DEAL

International Projector Corp. announces that Erpi has been appointed exclusive distributors of Simplex projectors in Brazil, China, Malay States, Straits Settlements, Siam, French Indo China, Borneo, Sarawak, Netherlands East Indies, Australia, and New Zealand. Simplex projectors have been sold for many years by responsible distributors in many foreign countries, and the arrangements with Erpi complete this world-wide distribution setup.

ALTEC DETROIT OFFICES

The Detroit office of Altec Service Corp. has moved to larger quarters in the same building, at 2111 Woodward Avenue.

UNIONS WANT BANK NIGHTS

Twenty-two units of the I. A. in 18 Iowa towns are straining to defeat a bill introduced in the State Legislature to ban bank nights. More than 300 I. A. members, it was announced, are working with theatre managers to retain bank nights, which are held in an estimated 200 Iowa theatres nightly.

ALTEC SIGNS 250 HOUSES

Altec Service Corp. will service Minnesota Amusement theatres in Minn., No. and So. Dakota and Wisc. With this deal, in addition to those already made with Randforce; Wilmer & Vincent, and Griffith Amusement circuits, a total of over 250 theatres have signed with Altec during the past month.

SUPREME INSTRUMENT CATALOG

A catalog of the new Supreme line of testing instruments is now available for all readers of I. P. upon request to Supreme Instruments Corp., Greenwood, Miss. Mention I. P. when writing to company.

16 MM. SALES UP 33 PER CENT

Sales of 16 mm. sound projectors for all sources, including portable road show units, increased by more than 33% during the

last part of 1937 and in 1938. Prospects are for equally good business during 1939.

KILL NEBRASKA I. A. BILL

The perennial favorite of Nebraska projectionists, the bill providing for a toilet in projection rooms in all cities of more than 10,000 population, has been killed in committee. A bill prohibiting walkathon contests, backed by the film business, was approved.

EASTMAN KODAK '38 EARNINGS

Eastman Kodak net profits for the year ending Dec. 31 last were $17,339,408, as compared with $22,347,345 for the previous year. Dividend on common stock is $7.54 per share, as against $9.76 a year ago. The company paid a two-million dollar wage dividend to employees on March 27.

BAIRD THEATRE TELEVISION?

Representative of Baird Television Co. of London, Eng., is now in the U. S. to explore the possibilities of manufacturing television receivers for theatres, preliminary tests of which have proven highly successful in England. Estimated price per theatre is from $5000 to $7000 for unit giving a 15 x 12 ft. screen image. Baird seeks a Broadway, N. Y. theatre for demonstrations.

PROJECTIONIST-SERVICEMAN AN IDEAL THEATRE TEAM

(Continued from page 17)

of the two push-pull 205-D rectifier tubes which obtain their plate voltage from the winding 5-6-7 of the power transformer in the control box. When one half (6-7) of this winding failed (as was the trouble in this case), one of the rectifier tubes was rendered inoperative, and the current in the plate circuit dropped approximately 50 per cent.

However, when the projectionist short-circuited R-6 and R-7, he reduced the grid bias on the remaining tube to zero, which caused the plate current of this tube to increase to where it approximated the normal plate current of both tubes operating normally. When the plate current approached normal, the control circuit caused the motor to develop sufficient power to bring it up to normal speed. From there on, the motor was able to carry on its own.

● Paging A Tin Bucket

The following story is still another one about a motor, but in this case, instead of the motor acting like a kid that didn't want to get to school on time, it acted like a whippet chasing the rabbit. In other words, when the Altec inspector received a call from the Arcade Theatre in Brookhaven, Mass., it was a case of one machine racing over speed, and the speed couldn't be regulated.

Knowing the idiosyncracies of that motor very thoroughly, the Altec inspector knew just what to tell the projectionist he could do until the inspector could get to the theatre. What he told him on the 'phone was, if you'll excuse my talking in riddles, how to operate a motor control cabinet type motor—without a motor control cabinet!

He told the projectionist to obtain an ordinary bucket, having an unpainted interior. Then to fill it with salt water made up of two or three ounces of table salt for each gallon of water. Next, the projectionist was to disconnect the leads from the motor which normally go to Terminals 3 and 4 of the 708 A control cabinet, connect one of these leads to the metal bucket, and connect the other lead to a piece of arc carbon. Then, he told the projectionist to immerse the piece of arc carbon in the salt water in the bucket, and to raise and lower—adjust the depth, that is—the carbon into the salt water until the motor operated to give approximately 90 feet per minute film speed!

By this makeshift arrangement, a very effective water rheostat was improvised,

ALTEC STOCKS SIMPLEX SOUND PARTS AGAINST EMERGENCIES

Altec Service Corp. has made arrangements with National Theatre Supply Co. to act as the latter's agent in stocking and distributing replacement parts for all types of 4-Star Simplex sound systems. Parts will thus be available from Altec stock points and warehouses during all theatre operating hours.

which could be accurately adjusted to cause the motor to operate at its normal r.p.m. As the Altec inspector explains it, here's the why-and-wherefore:

The drive motor involved was essentially of the repulsion type—that is, its speed is controlled by the external resistance in the armature circuit. Normally, the delicately adjusted circuits of the motor control cabinet automatically control this external resistance, so that the motor maintains a normal speed. However, the control cabinet can be dispensed with, and the motor made to operate at approximately normal speed by placing an adjustable resistance or rheostat in the external armature circuit and adjusting it manually. That's just what was accomplished by means of the homeopathic water rheostat at the Arcade Theatre.

● **A Word To The Wise**

Well, those are the stories I dug up this trip. But let me add to them just one word—accompanied by a very emphatic wagging of my finger—on the subject of playing tricks like this unless you know exactly what you're about, or unless the Altec service inspector says it's okay. I need only remind you that the power transformer in this motor control cabinet delivers a fairly husky current at 450 volts—or, in plain English, it can give you a shock the size of a healthy kick from a Jersey mule that's feeling awful mean. High voltage hazards are high voltage hazards, aren't they?

The stories themselves? They're pretty slick about some pretty slick cooperating, aren't they?

SURVEY OF CHANGEOVER SIGNAL DEVICES

(Continued from page 11)

taken from the film being projected, which automatically throws a switch to set in operation the incoming projector. At another point a cue is taken which actuates the douser control switch while at the same time operating the sound changeover. All parts are contained in a control cabinet mounted on the wall. Included are mechanical and electrical interlocks controlling the starting and stopping of motors, dousers and the sound.

● **Manual Aid Required**

This method requires manual resetting for each reel, thus efficient operation is somewhat dependent on the human factor. However, it does remove the need for the projectionist standing at a porthole to observe cues, thus releasing him for other duties.

D. Friction disc method. As the film unwinds from the upper magazine,

the speed of the reel therein increases. A friction disc attached to the upper magazine shaft drives a rotatable shaft on which is a pair of fixed sleeves. Weights are connected to these sleeves by means of pivoted links, causing an outward movement of the weights when the shaft rotates.

Increasing reel speed, as previously mentioned, causes the weights to pull outward, thus pulling the sleeve upward to a contact which closes the circuit and sets off an alarm. Variation in the time setting is accomplished by adjusting a set screw. Although a setting for a time interval can be made on each projector, it is necessary to operate a double-pole switch manually after each reel in order to receive a signal on the following reel and at the same time shut off the warning on the current reel.

E. Roller arm mounted in upper magazine. A set screw in this arm permits adjustment for an approximate predetermined interval, depending upon the amount of film still on the reel. When this point is reached by a small wheel riding on the emulsion, a spring action rings a bell. Varying thicknesses of film, splices, and reel diameters will naturally cause a variation of the timing. Approved exchange practice does not favor anything that functions through contact with the film.

F. Audio-visual dial signal. This is essentially a clock mechanism which is wound by a single twist of a combination pointer and knob. At the start of a reel the knob is turned until the pointer touches zero; pointer's position at end of reel indicates both the running time and the footage.

Each reel is given a consecutive number. A numbered marker is placed over the dial to indicate exact running time of each reel, remaining in place during entire run of show. Projectionist sets pointer to ring bell at any predetermined interval, either for striking the arc or to signal approach of cue mark. This operation is performed for each reel on which an audible signal is desired.

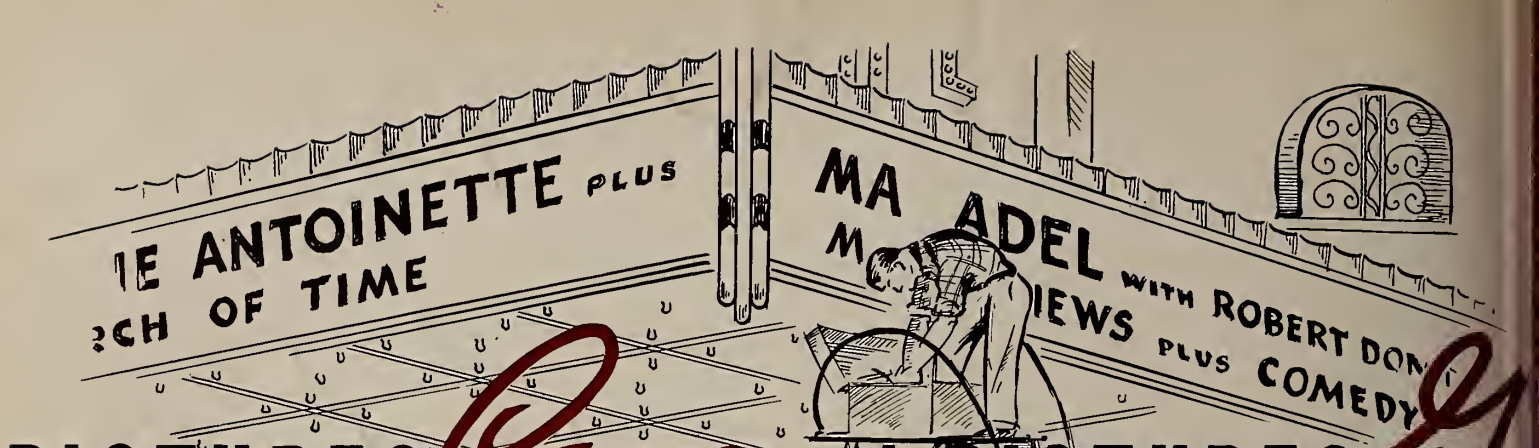
After the pointer is set, projectionist is able to observe remaining running time from a considerable distance. When actual reel footage is known, the time equivalent is noted on the dial. This device is not connected to the projector in any manner but is mounted on either the wall or the rewind table. It requires a manual motion to set for reel end signal. If no setting is made, this is evident by position of pointer at zero.

An upper magazine has recently appeared on the market which is equipped with a built-in signal device. This consists of a shaft attached to which is an arm having at its end a wheel which rides on the film. When the end of the reel approaches, a spring is released which sets off a bell signal. Notches are placed on the outside of the magazine, and by means of a pointer operating in conjunction with the inside arm, the projectionist has some measure of visual indication as to the amount of film run off in the upper magazine.

All these methods have as their common purpose an effort to run a smoother show. More cooperation between producers, exchanges and exhibitors would go far toward eliminating current evils in projection without the aid of any of the devices hereinbefore mentioned. Producers and their exchanges still handle prints on the basis of total running time of the subject—and herein may lie the reason for much of our troubles in this respect.

Each reel should be marked for exact footage, which would enable the projectionist to set up a schedule indicative of the exact time for the showing of each subject, much after the fashion of program timetables now made up for patrons' convenience. But where, oh where, is that cooperation between exchanges and projectionists without which keeping track of reel footages is an impossible task?

Personally, the writer can see no need for further overloading projector basis or cluttering up the walls or any other space in the projection room with additional equipment which inevitably serves only to increase the projectionist's duties and responsibilities by requiring attention to additional apparatus—thus defeating the very purpose for which it was intended.



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APRIL 1939

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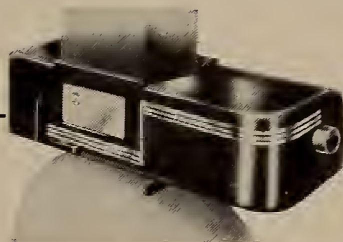

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Edited by James J. Finn

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Monthly Chat

THEATRE equipment sales are off about 25 per cent from the level of a year ago, according to reliable estimates, yet development work on new equipment is at the highest level reached within the past ten years. Two new projectors, at least two new lamps, a new rectifier—these are but a few of the items scheduled for early announcement. Inevitably, current happenings will mean a sharp realignment of policies in the supply field.

• • •

Readers of I. P. who contemplate visiting the New York World's Fair are cordially invited to avail themselves of the facilities of the I. P. office in the matter of hotel accommodations, reservations for amusements or for any chore which will help to make their visits more enjoyable. Ample advance notice is preferable.

• • •

Incidentally, projection will play a major role at the Fair, with hundreds of units being utilized by exhibitors to put over their messages. Units range in size from the very small spots to the massive one-ton projectors used by Eastman. Altogether an impressive demonstration of projection facilities, and truly an eye-opener in the direction of Projection Tomorrow.

• • •

A new type of shutter, reminiscent in some respects of those used about 20 years ago, is now finding not a little favor throughout the Middle West area. Apparently, serious differences of opinion exist as to the utility and efficiency of these shutters, a pair of which (for low- and for high-intensity arcs) have been sent to I. P. for test. Results will be announced promptly upon completion of the tests.

• • •

THAT double-truck spread relating to mercury vapor lamps which appeared in a recent issue of *Life* served to steam up some of the boys anent the possibility of early adaptability of these units to theatre projection. Relax, boys, relax; nothing has occurred to change the status of these units since a report thereon was last rendered in these pages. True, there have been adaptations of these lamps to projection work, but on no such scale as would warrant the enthusiasm generated in certain quarters by the *Life* presentation.

• • •

Our annual warning: Now that nice weather is here get out into the sun and gulp in huge draughts of fresh air as a means of stiffening resistance to the great gobs of carbon dust and sundry bacilli which have assaulted your frame through the winter months. A lot of the boys active a year ago are now sojourning (to use a nice term) in places like Saranac Lake and Arizona.

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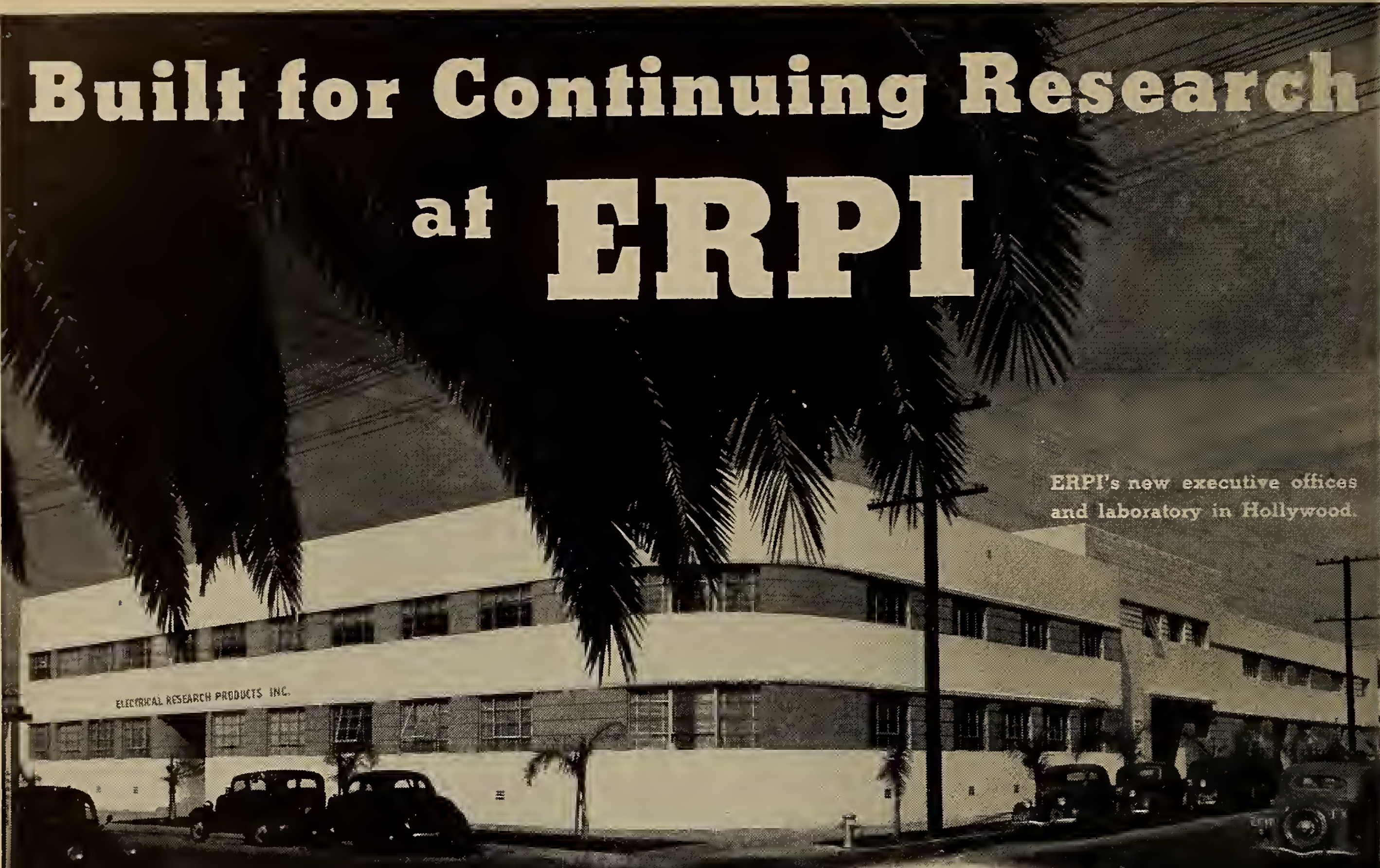
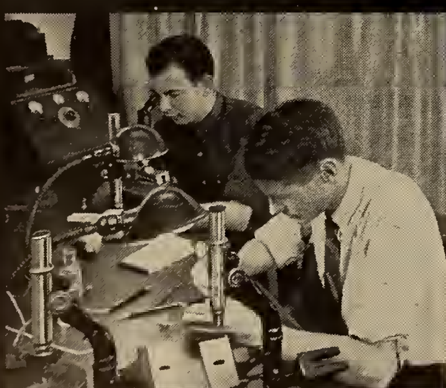


ERPI's new executive offices and laboratory in Hollywood.



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INTERNATIONAL PROJECTIONIST

VOLUME XIV NUMBER 4

APRIL 1939

Supplementary Sources of Service Data Anent Sound Systems

By *AARON NADELL*

COMPLETE wiring and schematic diagrams, necessary to locating trouble, are not always available. Sometimes they have been mislaid. Sometimes they cannot be obtained. There are manufacturers who do not supply wiring diagrams because they do not have them. There still are manufacturers, unfortunately, who will not supply circuits of any kind.

It is often possible to obtain data from other sources that will, to some extent, take the place of the complete schematic and wiring diagram. Like the diagrams, this type of information should be obtained far in advance of the day of need.

Consider tube socket connections. Sockets nowadays have many terminals. The wiring diagram, if complete, will show which is which, but the schematic will not. If the necessary information cannot be obtained from the manufacturer, it can often be found in the published data of a tube manufacturer. To refer to these data, it is only necessary to know the type of tube used in the socket, and that, if not shown on the socket, will appear on the tube itself.

Figure 1 is a section of the "tube chart" distributed gratis by one prominent tube company. It is not reproduced here for information, but merely by way of example. Only eight socket types are shown in Fig. 1; the full chart contains 75, and is not complete.

Each square of Fig. 1 carries an identifying number in its lower right corner. To use these illustrations, reference is made first to the body of the tube chart, which lists general characteristics such as heater current, plate voltage, amplification factor, and so on. One column of listings is devoted to "basing data"—that is, to numbers corresponding with those shown in Fig. 1. The basing data number for the tube under consideration is used to find which square of Fig. 1 (or of the other 67 squares) gives the socket diagram.

Some manufacturers supply a data sheet within the carton of each tube. These should always be saved. Because there is one in every carton, they become plentiful in the projection room, and the tendency is to throw them away. Then when the data they carry are needed, none can be found. A simple file may be made of such slips, after which duplicate copies can be discarded without loss. They almost always carry socket diagrams, in addition to other information of value.

Tube manufacturers, in some cases, also supply data in booklet form. Such books may devote one page to each tube type, and print the appropriate socket diagram on that page, no reference number needed. (The reference number system is, however, becoming universal for the newer type tubes, in view of the great multiplicity of modern socket arrangements). Tube booklets are gen-

erally sold for a nominal sum, being too expensive to give away. The common charge is twenty-five cents.

It is apparent that if an amplifier has, for example, six tubes, and supposing each socket to have six connections, the tube socket charts must give valuable information concerning one end of each of 36 different wires—a substantial percentage of any amplifier circuit.

● Other Tube Information

Socket details do not exhaust the usefulness of the tube data sheet, chart or booklet. The characteristics listed include some that are seldom of practical value in ordinary trouble-shooting (such as amplification factor and mutual conductance); some that are occasionally of value, if used cautiously, and some that are always helpful. The latter are the voltage and current data given for filament or heater; for meter readings taken on the amplifier should conform exactly, and if they do not, one amplifier fault has been definitely determined.

The tube is always, in every amplifier, operated at its rated heater voltage and current. Moreover, since heater (or filament) voltage is always low, and current comparatively high, no allowance need be made for meter resistance (see I. P. for March, 1937, page 24).

Other characteristics of voltage and current listed for a given tube do not, however, always apply exactly. A tube can be used successfully at other terminal values than those recommended by its manufacturer for normal operation, and plate and grid voltages are often varied by amplifier designers to suit their own requirements. A meter correction may also be needed when reading low-current, high-resistance circuits.

It is an excellent idea to take several complete sets of socket readings at times when the equipment is operating normally, average small differences if any, and to note them on the tube data slip, chart or book. Departure from those readings in time of trouble is then an obvious symptom which indicates promptly the circuits that need investigation.

● Resistor Data

The complete and perfect wiring diagram shows not only the location of every resistor in the equipment, but its rating in ohms. Some resistors, further, have their ratings stencilled on. The stencil method however, is being increasingly abandoned in favor of the color-code method, which is cheaper, and less subject to loss of information through heat, dust and aging. The color code is very simple, easily remembered, and highly practical.

Resistors change their value for any of a number of reasons including heating, corrosion in some cases, or breakage. But the information given by the ohm-meter may not be very useful if the trouble-shooter does not know what was the original rating of the part.

The resistor color code has been accepted by all American manufacturers who use the color method at all, and will always be the same regardless of the origin of the part. There are three colors: one on the body, one at the end, and one in a band around the body, or a dot located at or about the center. They must be read in the correct order, body first, and band (or dot) last. To remember the order remember the three letters BEB (body-end-band) or BED (body-end-dot).

There are ten colors, corresponding to the following figures:

Brown	1	Blue	6
Red	2	Violet	7
Orange	3	Gray	8
Yellow	4	White	9
Green	5	Black	0

These colors may be memorized with their corresponding numbers, or the list just given copied off and filed where it can easily be found. Some manufacturers will send resistor color code cards on request.

Reading the colors of any resistor, the body color, taken first, indicates the first digit in the ohmage rating. Supposing the body to be red, that digit is 2. The

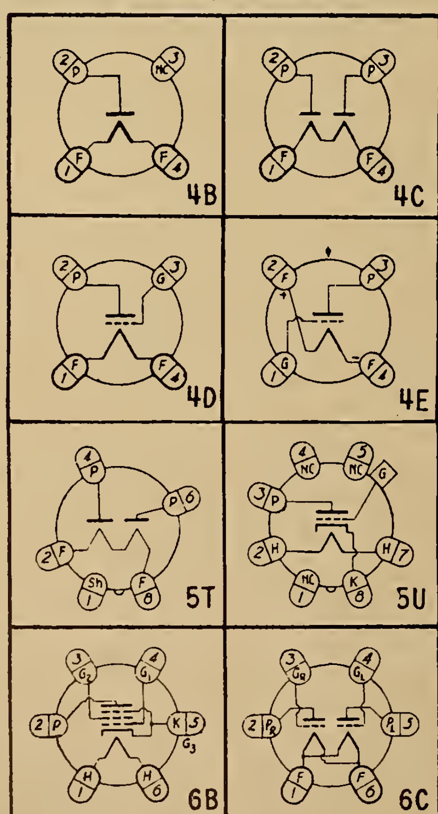


FIGURE 1

Basing views showing bottoms of the sockets

next color, end, gives the second digit. If it is yellow, the corresponding digit is 4. The band or dot color does not stand for a figure, but for the *number of zeros* to follow after the first two figures. If it is black, *no zeros* follow in the example given, and the rating is 24 ohms. If, however, the dot in the same example is brown, 1 zero follows, and the rating is 240 ohms. It is obvious that intermediate ratings, such as 245 ohms, or 24,500, cannot be shown in this code. The nearest available rating is used instead.

Table A may be used for many common values, although it is usually handier to remember the code and use it without reference to any tabulation except perhaps that of color values, as listed above. In the larger tabulation the lefthand column or figures (which will be more useful in the case of condenser coding, as will be seen) can be ignored as far as resistance is concerned, or treated as representing megohms.

The right-hand column of figures represents ohms. Next come three lines of colors, body, end, band. Thus at the bottom of the column a brown body (1) followed by a black end (0), followed by a blue band (6 more zeros) totals an ohmage of 10,000,000. The chief thing to remember is that the last color, the dot or band, does *not* represent any figure, but for a given number of ciphers.

The color rating must never, in any circumstances, be compared too literally with the ohm-meter reading. Discrepancies up to as much as ten per cent emphatically do not always represent trouble. In the first place the rating method, as just shown, does not take care of intermediate values. It can show a value of 10,000 ohms or of 11,000 ohms, but not one of 10,500. In the next place many modern resistors, used at non-critical points of a circuit (that is, points where some small departure from rated value will have no important effect on performance), are not invariably accurate as to rating.

● Condenser Data

Resistors that come within one per cent of their rated value are sold at a premium, and variations of as much as five per cent are not uncommon. Some of the cheaper types (still satisfactory for certain limited uses) may not come closer than within ten per cent of the resistance at which they are rated. A discrepancy of more than ten per cent generally indicates some fault, raising the question of whether a change in the value of the resistance unit in question could account for the type of trouble experienced or can in any way indicate the possible source of that trouble.

Condensers are rated by a color code

TABLE A

.0002	200	Red	Black	Brown
.0004	400	Yellow	Black	Brown
.0005	500	Green	Black	Brown
.0006	600	Blue	Black	Brown
.0007	700	Violet	Black	Brown
.0008	800	Gray	Black	Brown
.001	1,000	Brown	Black	Red
.0012	1,200	Brown	Red	Red
.0015	1,500	Brown	Green	Red
.002	2,000	Red	Black	Red
.0025	2,500	Red	Green	Red
.003	3,000	Orange	Black	Red
.0035	3,500	Orange	Green	Red
.004	4,000	Yellow	Black	Red
.005	5,000	Green	Black	Red
.006	6,000	Blue	Black	Red
.007	7,000	Violet	Black	Red
.0075	7,500	Violet	Green	Red
.008	8,000	Gray	Black	Red
.009	9,000	White	Black	Red
.01	10,000	Brown	Black	Orange
.012	12,000	Brown	Red	Orange
.015	15,000	Brown	Green	Orange
.017	17,000	Brown	Violet	Orange
.02	20,000	Red	Black	Orange
.025	25,000	Red	Green	Orange
.03	30,000	Orange	Black	Orange
.04	40,000	Yellow	Black	Orange
.05	50,000	Green	Black	Orange
.06	60,000	Blue	Black	Orange
.07	70,000	Violet	Black	Orange
.075	75,000	Violet	Green	Orange
.09	90,000	White	Black	Orange
.1	100,000	Brown	Black	Yellow
.12	120,000	Brown	Red	Yellow
.15	150,000	Brown	Green	Yellow
.2	200,000	Red	Black	Yellow
.25	250,000	Red	Green	Yellow
.3	300,000	Orange	Black	Yellow
.5	500,000	Green	Black	Yellow
.75	750,000	Violet	Green	Yellow
1.	1,000,000	Brown	Black	Green
1.5	1,500,000	Brown	Green	Green
2.	2,000,000	Red	Black	Green
3.	3,000,000	Orange	Green	Green
2.5	2,500,000	Red	Black	Green
4.	4,000,000	Yellow	Black	Green
5.	5,000,000	Green	Black	Green
6.	6,000,000	Blue	Black	Green
7.	7,000,000	Violet	Black	Green
8.	8,000,000	Gray	Black	Green
9.	9,000,000	White	Black	Green
10.	10,000,000	Brown	Black	Blue

similar to that used for resistors, but since their shape often differs, a row of three-colored dots may be substituted for the body-end-band system. Where such a row of colored dots is found, an arrow, printed or moulded near them, will indicate the order in which the colors are to be read.

Their numerical significance is the same as in the case of resistors, but it is important to remember that the quantity signified is not microfarads, but micro-microfarads, or 1/1,000,000th of the quantity usually desired. It is therefore necessary to *divide* the indicated number by 1,000,000. (The smaller the measuring unit used, the larger will be the figure that designates the equivalent quantity; thus 1 mmfd. is the same as .000001 mfd.).

In Table A the extreme left-hand column may be taken as microfarads, the column next to it as representing micro-microfarads. The color code will give results falling within the figures of that column, which may then be translated by reference to the tabulation, or more simply and with less delay by deviding by one million.

● Miscellaneous Sources

It should be noted that in the case of condensers also the color code fails to give intermediate values, such as 275,-000, but is restricted to a choice between 250,000 and 300,000; further, that condensers, like resistors, do not always conform strictly to their rated values. In most cases, fortunately, a ten per cent condenser variation will produce no trouble except for a small shift in frequency response, probably not discernible to the ear.

Just as the packing slip included with some tubes may contain highly useful information not shown on the tube itself, so many shipments of spare or replacement parts received by the theatre are often accompanied by data which the actual part does not carry. Resistance or condenser ratings may be shown on the carton or even on the bill, and nowhere else.

Transformers in particular often carry highly pertinent data in a form which is detached when the part is installed, and then usually is lost. A power transformer with many terminals for different voltages, or a sound transformer with terminals for a large number of impedances, must be marked in some way to show the terminal combinations available for different purposes.

Sometimes these data are stencilled on the part, and can always be found by brushing off accumulated dirt. More often the terminals emerge through a printed cardboard on which the necessary information appears. After the part has been installed (with the help of reference to the cardboard) the data are generally considered of no further use and thrown away.

However, if the transformer develops trouble, not all of it may go bad at the same time. It is very possible that only one winding will burn out, and that suitable connections to other terminals will give an entirely satisfactory emergency substitute for the required voltage or impedance. The same is true of transformers equipped with color-coded leads instead of terminals. A data sheet indicating the correct color combinations for different purposes invariably accompanies such units; and again is generally thrown away when the part has once been wired in.

● Availability of Data

All such material should be saved. In the case of multiple-terminal information of the kind just referred to, the information should be kept even when complete drawings of the sound equipment are at hand. It is unlikely that those drawings will give data by which satisfactory emergency connections can be made to a transformer with one burned-out winding.

There is no difficulty about filing useful information where it will be instantly available. No elaborate filing system is needed. All that is necessary is a folder, a loose-leaf book or even a simple envelope for each component piece of apparatus—that is, each amplifier, sound head, power unit, *etc.* In that envelope or book should go all data applying to a particular unit. If the same information also applies to some

other unit, it may be copied, or a cross-reference noted in the other unit envelope.

If the schematic and wiring diagrams are available or can be procured, they constitute the most important single items of information. They alone may be left bound in an instruction book, rather than filed, provided they are received that way. Meter readings recorded when there is no trouble, for purposes of comparison, may be noted on these drawings, or (if the drawings are crowded) listed separately. All supplementary information is also either noted on drawings, or filed as indicated.

Envelopes or loose-leaf books containing trouble data may in some cases be kept right inside the amplifier or other panel to which they refer. A much better method, provided they will not be lost, is to keep them handy for periodic refreshing of the memory. Data kept in mind are more quickly available than that kept on paper; but the written notes obviously should be ready at all times to make sure memory doesn't slip a cog.

The Epoch of Progress in Film Fire Prevention

By *ALFRED F. SULZER*

VICE-PRESIDENT, EASTMAN KODAK COMPANY

The appended article is an abstract of an address delivered recently by Mr. Sulzer before the Greater New York Safety Council. The safety story of the motion picture industry is a remarkable one, and to none more absorbing or important than to projectionists who daily handle miles of film and whose interest in fire prevention grants precedence to none. Certain aspects of this article are discussed in an editorial which appears elsewhere in this issue.

IT IS a privilege and an honor to be asked to present the story of the accomplishments in fire prevention in the motion picture industry. The Eastman Kodak Co., having developed and introduced the flexible, transparent film that made the motion picture industry possible, and because of its long experience in the manufacture of this film, is undoubtedly in the best position to outline this problem in its entirety.

To understand the magnitude of the problem and the difficulties involved in fire prevention in the motion picture industry, we must go back to the beginning of the use of film in photography. In 1880, when Mr. Eastman began the manufacture of dry plates, he realized that photography could not be made popular with the average individual until something less bulky and less breakable than glass-plate negatives could be produced.

In 1885 he first introduced stripping film, as it was called, which consisted of paper, coated first with a layer of soluble gelatin, then with a thin layer of collodion (nitrocellulose), and finally with a coating of sensitized emulsion. The film was exposed by the photographer, then sent back to the Company, where it was developed and laid emulsion-side down on a glass plate. The soluble gelatin layer was then softened and the paper was stripped off, thus leaving a transparent negative on the glass plate for printing.

Although this next development, stripping film, broadened the field of amateur photography considerably, Mr. Eastman realized that it was not the final answer. He therefore employed a chemist in 1886 to devote all of his time to the development of a suitable flexible, non-breakable, transparent material which could replace the paper of the stripping film and also serve as a permanent support for the sensitized emulsion.

Collodion, which is a solution of cellulose nitrate in ether and alcohol, had been used in wet-plate photography, the method that replaced the early Daguerreotype process. It was the best-known and practically the only-known transparent material that would form itself into a continuous film when the solvents were evaporated. The film formed from collodion was found wanting, however, in many respects as a support for photographic emulsions.

Mr. Eastman was familiar with collodion from his experiments with wet-plate photography before he developed the Eastman gelatin dry plate with which he began his business career in photography. His later experiments in search of a transparent, flexible emulsion-support demonstrated the unsuitability of collodion for this purpose. Despite the defects of collodion, however, it was natural that the experimenter should concentrate on nitrocellulose, its main ingredient, in his search for a transparent, flexible support. After 3 years of experiments, a formula of nitrocellulose and camphor in solution, suitable for negative support, was perfected, and commercial production of nitrocellulose film base was started in 1889.

● Properties of Nitro Film

Nitrocellulose is inflammable. Inflammability increases with the degree of nitration of the cellulose. Experiments demonstrated that, to produce a nitrocellulose suitable for film support, a low degree of nitration must be maintained so that the resulting nitrocellulose would be less inflammable, less subject to decomposition, and of the correct solubility.

Nitrocellulose as used for photographic purposes is not explosive, but is inflammable; and intelligent care must be exercised in its production, storage, and use. Nitrocellulose film base will not only burn rapidly when ignited, but also, if subjected to sufficient heat, will decompose without flame. This film base contains enough combined oxygen to maintain decomposition when once started, even in a limited air supply. Decomposition liberates comparatively large quantities of carbon dioxide, carbon monoxide, and oxides of nitrogen, which under certain conditions are dangerous to life. Some of these liberated gases are also inflammable, and under some conditions are explosive.

Since decomposition, when once started, will maintain itself and generate enough heat to produce combustion, the obvious control, lies, not in methods intended to smother the fire by excluding the air supply, but by the application of large quantities of water sufficient to cool the burning film below the decomposing temperature of about 300 degrees F. Experiments demonstrated that such an application of water will also cool the liberated gases sufficiently to make explosion and even ignition, unlikely. This theory was followed in fire-protection measures developed by the Eastman Kodak Co., to which we will refer later.

Nitrocellulose film was first used only in roll film for amateur photography. The development of equipment for the taking and subsequent projection of pictures which would seem to move had been waiting, however, for a flexible film. Therefore, almost immediately after Mr. Eastman announced the availability of flexible negative material, Thomas A. Edison, realizing that this was the answer to one of his most perplexing problems, sent one of his men to Rochester to bring back samples with which he might carry on his experiments on motion picture cameras. Mr. Edison's first confirming order, covering a prior delivery of motion picture film, bears the date of Sept. 2, 1889.

● First Commercial Shows

Motion pictures first appeared commercially in peep shows in 1894. Then, on May 20, 1895, the first motion pictures were projected on a screen commercially, at 153 Broadway, New York City. This was a four-minute picture

(*Continued on page* 21)

Enormous screen—22 feet high and 187 feet long—on which are projected single panoramic views and groups of pictures

Giant Twin Projectors Feature Novel Eastman Fair Exhibit

THE scene is inside a huge building at New York's 1939 World's Fair in which is housed the exhibit which reflects the far-flung activities of the greatest photographic company in the world—Eastman Kodak. Passing through a dimly lighted foyer, the visitor enters the Great Hall of Color—a majestic, semi-circular room 65 feet in radius with a total area of 6500 sq. feet. Here he will see the most extraordinary photographic pageant in history, which utilizes projection facilities hitherto undreamed of by even the most advanced practitioners of the art.

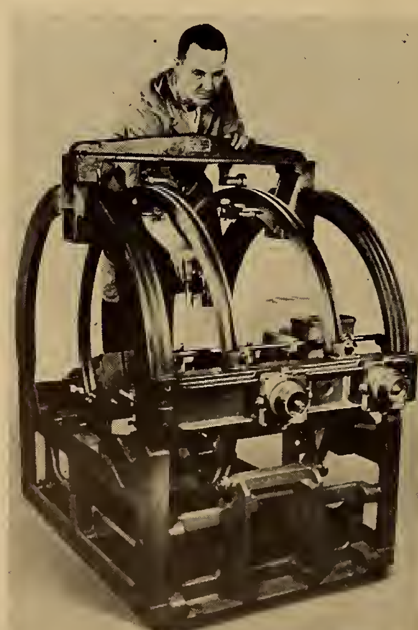
An enormous screen—22 feet high and 187 feet long, extends along the entire inner circumference of the Great Hall. Along this screen, in single panoramic views and in groups of pictures, there passes the greatest show of color photography ever seen.

● Continuous Color Projection

Before the crowd's eyes, familiar scenes melt into places strange and far away. Time is condensed along with space as the world passes in review. Summer fades swiftly into winter, and just as swiftly back to summer again. In a few breaths, a majestic Western canyon scene changes from dawn to mid-morning, to noon, and declines through afternoon into night. Hundreds and thousands of pictures join in the kaleidoscopic march—pictures of people young and old, at work and at play—scenes of sunshine and mist and twilight—flower garden and park and woodland—shimmering blue water and skies rich with the glory of sunset.

The screen is never dark. One 187-foot scene or group of scenes dissolves into the next, smoothly. Single pictures in groups of eleven are interspersed between the panoramic views—and all in rich, glowing color.

It is a spectacle so dazzling as to be almost incredible. Even less credible to many, will be the fact that these huge screen pictures are projected from small full-color transparencies little larger than a special delivery postage stamp. The interest of those who will view this spectacle will be divided between the color pageant and the mechanical ingenuity which makes such an exhibit possible—and this is where the projectors demand attention.



Here are shown only the frame and lenses of one projector and, back of lens to the right, one of the lamphouses and heat filter. Weight, 2700 pounds

Each projector is a "twin"—two projectors in one—and each weighs nearly a ton. Nearly as tall as a man, the projectors bear no resemblance to conventional projection equipment. In them, each of two 45-inch steel drums carries 96 color transparencies, firmly mounted on glass. Special gates and shutters are used for "fades" and "dissolves."

● Use 11 Twin Projectors

Eleven similar twin projectors are concealed in a spacious projection room just under the roof of the great hall. Through each of their gates stabs a brilliant beam of light. Tiny color-film transparencies, about 1 x 1½ inches, made on standard Kodachrome film, pass these gates—to become full-color screen pictures approximately 50,000 times as large in area! Each of the screen pictures is 17 feet wide and 22 feet tall, and eleven of them *exactly* fill the 187-foot screen. Interestingly, the transparencies which produce these enormous pictures were made with cameras similar to those used by thousands of amateurs.

As each small full-color transparency comes into position, it is registered in

place to an accuracy of plus or minus 1/10,000 inch, through a unique combination of optical and mechanical registration. Moreover, this same registering system operates so that even while the transparency is in motion in the projector gate, its enlarged image is held rock-steady on the screen.

Each of the hidden projectors is synchronized with the others by an elaborate interlock—operating through a fully-automatic control system. To design them, and their operating system, involved hundreds of hours of planning and computation; and thousands of dollars went into their construction.

Through its electrical interlock and control mechanism, the projection system can be operated with infinite flexibility. If desired, pictures can be changed at different speeds—one group of pictures remaining on the screen a half-minute, while others are changed up to four times a second. Fades, dissolves, motion effects can also be presented.

Appropriately enough, the "heart" of the projection system control is a specially notched sound-film, which not only carries the voice of a commentator and special musical accompaniment, but also regulates the movement of the projector shutters and the shifting of slides—keeping pictures and comment in perfect synchronism. With this special "index" film control, it is possible to start a cycle of the color show simply by throwing a switch—and to halt all the projectors simultaneously just as simply.

Designed by Eastman technicians, these projectors apply a wholly new principle to color-film projection. They are so adaptable that they can be used for any type of slide projection which calls for high magnifications.

Huge fine-pitch ring spur gears are largest of type ever made. Each has 1440 teeth. Color slides are bolted to these "drum" gears—96 to each drum

Employed in the Eastman projectors are the largest fine-pitch precision ring spur gears ever machined in the U. S. Each gear is 45 inches in diameter and carries 1440 teeth. On these "drum" gears are bolted glass-mounted Kodachrome transparencies—96 pictures to a drum. Twenty-two gears are used in the eleven twin projectors, so that the system carries 2,112 color-film pictures ready for automatic projection.

To link the gear-sings with the automatic indexing system, the projectors employ one of the largest single-step spur gear reductions ever attempted—48 to 1. The 45-inch gears work directly from a 15/16-inch pinion. Each color slide carries a series of gear teeth, integrally mounted along its edge. Together, these teeth form a continuous series around the film ring, and serve to operate the optical registering system built into each film gate.

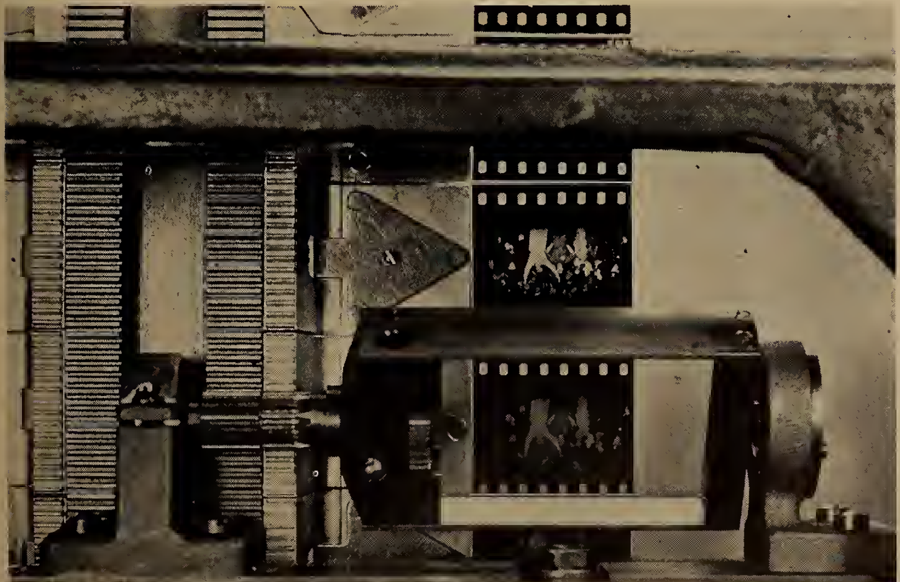
This registering means consists of a small rectangular plate of selected optical glass, which spins as the film ring rotates. As each picture moves into position, this glass swings upright before it. If the picture halts a trifle too high in the gate, the registering-glass remains tilted slightly forward at the top. If the picture stops too low in the gate, the glass tilts back correspondingly, its movement being controlled by the gear teeth on the film. In either case, refraction through the glass shifts the picture-image so that it travels at proper level through the lens, and is correctly positioned on the screen.

This correct level is maintained even if the color-slide vibrates up and down in stopping, since the registering glass moves in synchronism with it. Such a means of optical registration has heretofore been found only on ultra-speed laboratory cameras, used for taking pictures at 1/100,000 to 1/500,000 second; but in the Kodak Building projectors, it helps provide screen registration of unparalleled accuracy.

The illuminating system of each projector is centrally housed, with the ring gears and file drums revolving around it. Water cells are used for cooling, and in addition, a blast of air, chilled almost to freezing, is directed on each projector gate. Large-aperture, long-focus projection lenses are used, and specially designed shutters are utilized.

Eastman prepared a special collection of more than 100,000 Kodachrome transparencies. The design of the Kodak projectors makes it possible to change the whole color show overnight, simply by unbolting one group of slides, and replacing them with another. Pictures will be shown continuously from 10 P.M. each individual show lasting approximately twelve minutes and utilizing more than 2000 full-color slides.

The tiny full-color slides used in projection are identical with those any amateur can make today with a miniature camera. They were made on the same types of Kodachrome Film the amateur uses, are the same size, and—if remounted as regular 2 x 2-inch slides—could be shown in any inexpensive home projector.



Optical registering device, a small plate of selected optical glass which spins as the film drum turns. Refraction effect can be observed. Slide is somewhat high in gate, but gears automatically tilt registering-plate forward, centering image precisely

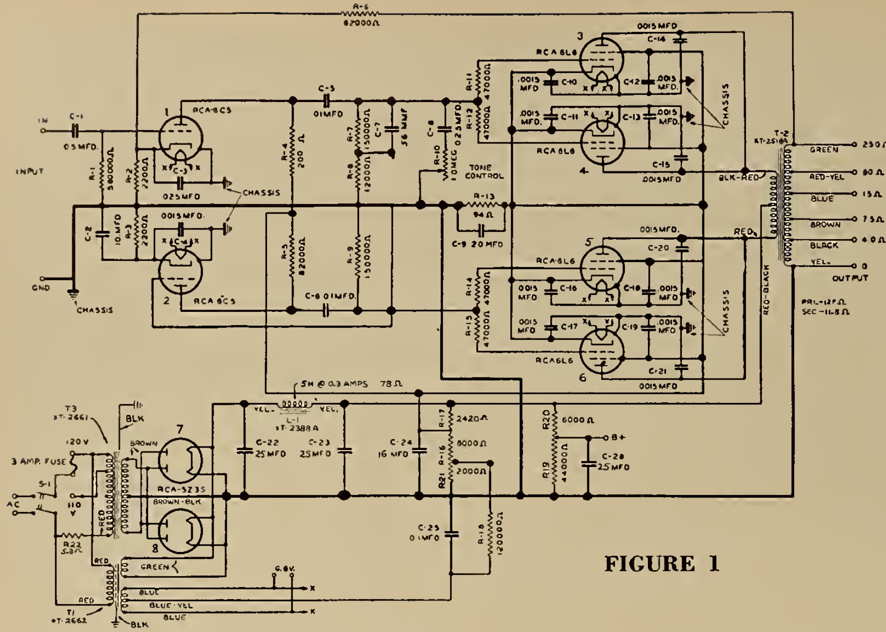


FIGURE 1

Seventh Subscription Contest Diagram

LAST month's Contest diagram (Fig. 1), although comparatively easy, netted only ten winners out of an extremely large number of contestants. Many more entries would have scored except for two oversights committed by an astonishing number of contestants who otherwise turned in first-rate replies. Not a few men failed to note the obviously low value of the plate resistance of Tube No. 1. Similarly, many contestants failed to see that Tube No. 6 screen grid was grounded to shell—which is surprising, indeed, since the other three 6L6 tubes offered a perfect basis for comparison.

Those who scored in last month's contest follow: H. D. Taylor, Raleigh, N. C.; V. H. Brant, Conway, Ark.; Fred Snodgrass, New Martinsville, W. Va.; Herman Polies, Miami, Fla.; Paul Meilink, Sandusky, Ohio; E. J. Doolittle, Baltimore, Md.; C. H. Siddall, Azusa, Calif.; B. G. London. Stamford, Conn., and R. W. Rushworth, Baltimore, Md.

There were two other successful contestants who will receive no credit for their efforts because of the oft-repeated rule requiring that all entrants be subscribers to I. P. No consideration will be extended to replies received from non-subscribers.

The changes made in the March diagram were:

Connection dot added where the rectifier filament jumper crosses the ground bus.

Connection dot added between No. 2 grid line and line running to the right from C-6.

Section of wire removed between the ground bus and the connection running to the right from R-8, R-7 to the lower end of C-7.

Plate load of No. 1 tube changed from 82,000 ohms to 200 ohms (R-4).

Short added between the right side of R-3 and the screen grid line.

No. 6 screen grid grounded to No. 6 shell by addition of dot.

This month's Contest offering (Fig. 2) presents no particular difficulty to those projectionists who know their circuits and who are able to painstakingly trace them through. As is customary, practically the entire circuit has been redrawn, so it is useless to attempt thus to check upon the changes made. The usual rules will prevail: only subscribers to I. P. are eligible to compete; and all answers must reach I. P. not later than May 22.

It is not necessary to enclose a copy of the diagram in order to receive consideration. Simply list the errors found, append your name and address, and mail to I. P.

Simplex Adds E System to Reproducer Line

Supplementing its present line of sound reproducers, International Projector Corp. has just announced a new Simplex E reproducing system designed expressly for small theatres. The system differs radically from other 4-star models only in the matter of power, its output being 10 watts. The motor and soundhead are unchanged, there is only one volume control, and there has been some slight modification in speaker equipment. Dividing mark for low- and high-frequeny is 800 cycles, this figure being adjudged best for small auditoria.

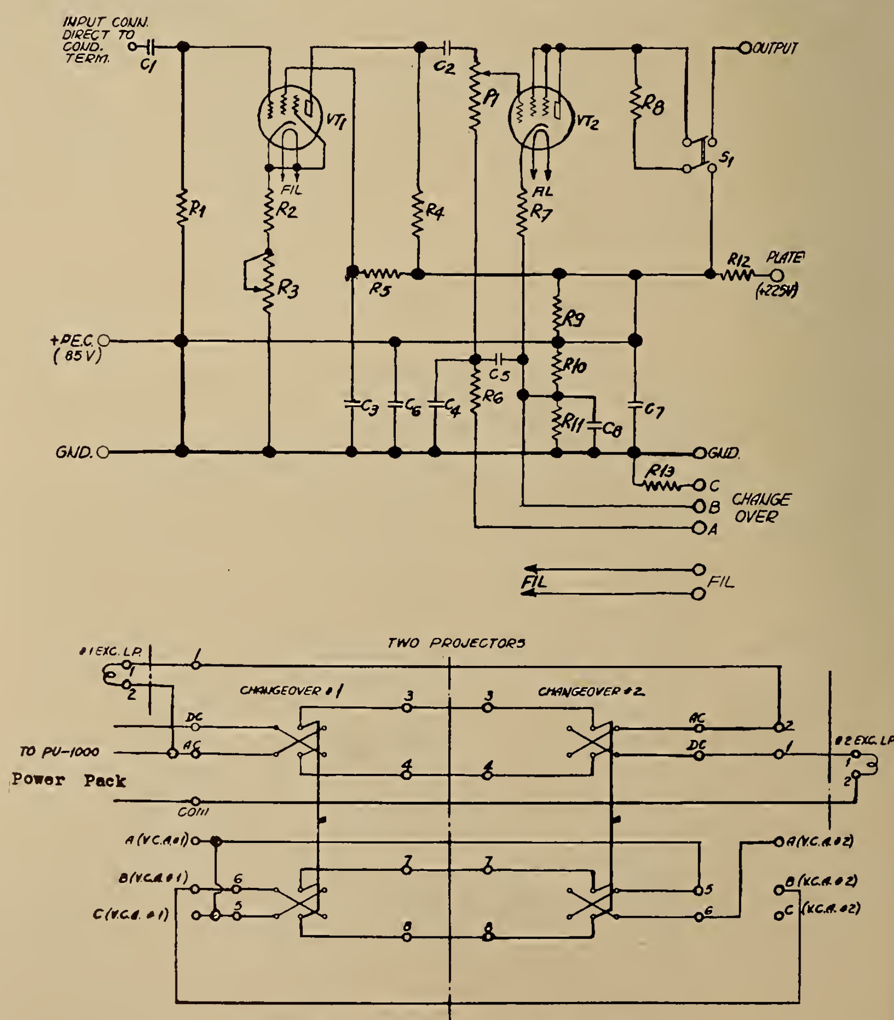


FIGURE 2. *Volume Control Amplifier*

An Analysis of Light: Terminology and Procedure in Plotting Curves

BY THE ENGINEERING DIVISION, NATIONAL CARBON COMPANY

Vitally important to a thorough understanding of the projection art is a knowledge of light, its composition and action, and this in turn requires a familiarity with the terminology employed by those who work with light. This need is filled, and admirably so, by the accompanying article, which merits most earnest consideration by every projectionist.

IN THE technical discussion of light it is frequently necessary to define the characteristics of radiation from a given source in exact terms. To understand the meaning of such definition it is essential that one have knowledge of the generally accepted theory of light radiation.

Light is known to be far more complex than it appears to the human eye. The eye cannot separate a beam of light into separate components of different colors. It sees only the resultant effect of all colors that may be present. Yet, by passing a beam of white light from any source through a prism, a piece of glass or quartz of blunt wedge shape, it can be spread out into a band of brilliant color ranging from red through orange, yellow, green, blue and violet. This separation of light into its component parts is called a *spectrum*. The rainbow is the spectrum of sunlight refracted through the raindrops upon which it falls.

Another shortcoming of the human eye is that it does not respond to all of the spectrum spread out before it by means of the prism or that other more accurate optical device known as the diffraction grating. It has been known for a long time that sunlight includes radiations beyond the red portion of the spectrum but invisible to our eyes. These have been termed the *infra-red* or heat rays. Invisible rays at the opposite end of the spectrum have also been discovered. These are called *ultra-violet*, that is, beyond the violet.

While light rays can be referred to as ultra-violet, luminous (visible) or infra-red and the luminous rays further identified by color sensation produced on the eye, it is often desirable to define a particular ray or band of rays more specifically. It is known that light has many of the properties of a vibration or wave-motion. These waves are much like the ripples which spread from a point where a stone has just been dropped into a quiet pool.

The Visual Spectrum

There is a tremendous difference, however, in the speed with which the light waves travel as compared with the waves of water. Light waves travel at a speed of approximately 186,000 miles, or 300,000,000, meters per second, which means that the time required for light to travel the 93,000,000 miles from the sun to the earth is about 8 1/3 minutes.

Light waves are part of the same family which includes radio waves, infra-red waves, ultra-violet waves, X-rays, *etc.* Fig. 1 shows a chart illustrating the relationship of all these various waves to those which go to make up the visual spectrum. So far as we know, the speed and fundamental nature of all the waves in this series are identical. They differ, however, in their frequencies and wave-lengths. By *frequency* we mean the number of complete waves or cycles passing a given point in one second; and by *wave-length* we mean the distance between the successive wave crests.

Let us analyze for a moment the radio broadcast band shown in Fig. 1. We see that this band includes radiations with wave-lengths which range between 200 and 545 meters. The frequency with which these wave-lengths pass a given antenna is obtained by dividing the velocity (300,000,000 meters) by the wave-length in meters or

Velocity÷Wavelength=Frequency

For wave-lengths of 200 meters the frequency is 1,500,000 waves or cycles per second, and for wave-lengths of 545 meters the frequency is 550,000 cycles per second. These frequencies are more commonly expressed in *kilo-cycles.* One *kilo-cycle* is equivalent to 1,000 *cycles.* Expressed as such, these two frequencies are 1500 and 550 kilo-cycles per second, respectively. We are familiar with these terms, as they represent the divisions

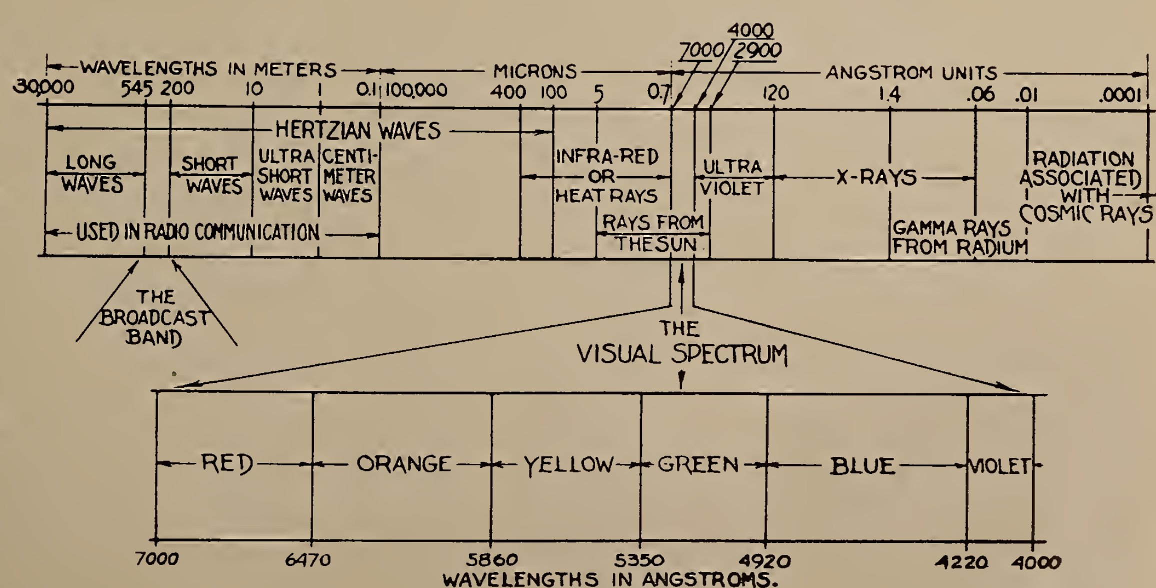


FIGURE 1

The radiation spectrum

TABLE A

1 Micron = 1/1,000,000 meter
1 Millimicron (a unit often used) = 1/1,000 micron
1 Angstrom Unit = 1/10 millimicron; 1/10,000 micron; 1/10,000,000,000 meter
1 Angstrom Unit equals about four billionths of an inch
10 Angstrom Units=1 millimicron
10,000 Angstrom Units=1 micron

commonly used on the dials of our radio sets.

A little further analysis of the wave-lengths used for radio communication outside of the regular broadcast range shows that these waves range from 0.1 meter (4 inches) to 30,000 meters (20 miles) in length. The corresponding frequencies for these two extremes are 3,000,000 kilo-cycles and 10 kilo-cycles respectively. In dealing with these higher frequencies the term *mega-cycles* is generally used. A *mega-cycle* is equal to 1,000 *kilo-cycles* or 1,000,000 *cycles.* For instance, the 3,000,000 kilo-cycles mentioned above can also be expressed as 3,000 mega-cycles.

A further analysis of the Radiation Spectrum (Fig. 1) reveals that the various wave-lengths shown are expressed in three different units namely meters, microns, and Angstrom Units. These units all bear a decimal relationship to the meter, as shown in Table A.

● Definitive Units

It is evident from these figures that the wave-lengths shorter than those in the radio band are extremely short and the frequencies are so high that it is not convenient to express them in everyday units. For this reason the physicists have adopted the units shown in Table A. This permits definition of wave-lengths in integral values instead of cumbersome fractions. It is also true, in dealing with the Radiation Spectrum beyond the radio bands, that the frequency nomenclature is seldom used.

As shown by the previous equation, a fixed relationship exists between frequency and wave-length, so that a complete specification is provided by the use of either one of these terms alone. The Angstrom Unit is the one most commonly applied by physicists to that part of the Radiation Spectrum defined as ultra-violet, visible and infra-red. This unit bears the name of the Swedish physicist Angstrom.

It will be noted that the region of the Radiation Spectrum covering the range of visual light extends from 4,000 to 7,000 Angstrom Units. This narrow band of radiation is of very great importance because the human eye is responsive to radiation of wave-lengths within this range. It will also be noted that this region is immediately bounded by *infra-red* rays (heat rays) on one side and by *ultra-violet* rays on the other side, neither of which rays are visible to the human eye.

Other than the fact that the human eye is stimulated by the visible rays, these rays are the same in general character as those on either side. The wave-lengths in these adjacent bands are such that it is convenient for us to apply the same unit of measurement in defining them.

The visual spectrum (4,000 to 7,000 Angstrom Units) has been enlarged in the lower part of Fig. 1 to show the relationship of the various colors of light of which it is composed. A sensation of red is produced when radiation of wave-lengths from 6470 to 7000 Angstrom Units strikes the eye. Likewise a sensa-

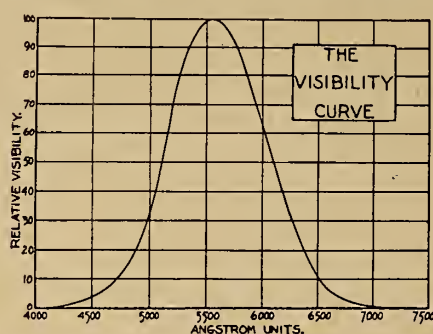


FIGURE 2

tion of orange is produced by wave-lengths of from 5860 to 6470 Angstrom Units. Shorter wave-lengths stimulate other color sensations such as yellow, green, blue and violet. Table B summarizes this information with wave-length and frequency specifications in a variety of units.

These color divisions of the spectrum are only approximate. Each color shades by imperceptible degrees into the next one and we cannot say definitely where orange ends and red begins. We can define color exactly, however, by placing Angstrom's scale of wave-lengths beside the spectrum and noting the number that corresponds to the particular color in question.

When we speak of radiation of so many Angstrom Units we define the position of that particular ray of light in the spectrum, whether it be in the ultra-violet, visual, or infra-red region. The description means the same thing to everyone familiar with the Angstrom Unit scale.

We have mentioned previously that the human eye does not respond equally to all wave-lengths. If the eye were subjected in turn to radiation of a number of wave-lengths over the visual range, all of equal energy value, the relative response would be indicated by the familiar visibility curve, Fig. 2. This curve shows that the eye is most efficient at a wave-length of 5,500 Angstrom Units.

The same amount of energy at wave-lengths of 5,100 AU or 6,100 AU produces only half as much visual response; while at 4,000 AU and 7,000 AU the response of the average human eye is practically zero. Actually the average response at 4,000 AU is 0.009 percent of that at 5,500 AU, and at 7,000 AU it is 0.3 percent. This is also another way of saying that different color sensations are stimulated to different degrees when light or different wave-lengths strikes the eye. However, if radiation of all wave-lengths between 4000 and 7000 Angstrom Units is present in substantially equal amounts, then no one color predominates and we say that the light is white. This is an important point to remember in the discussion which follows.

● Plotting Light Curves

By means of an instrument known as the spectroscope it is possible to show the spectrum of any light source, either natural or artificial, and with the further aid of sensitive detecting instruments such as thermopile, the photo-electric cell and the photographic plate, study the characteristics of the given light source from a quantitative as well as a qualitative point of view. It was by this method that the Spectral Energy distribution curves of the light from the National SRA and National Suprex carbons shown in Figs. 3 and 4 were obtained.

These curves show the distribution of energy from these two light sources from

TABLE B

Color Stimulated	Wave-Length Range: Angstroms	Wave-Length Range: Microns	Millionths of an Inch	Frequency Range: Trillions of Cycles
Red	6470-7000	.647-.700	25.5-27.6	429-464
Orange	5860-6470	.586-.647	23.1-25.4	464-512
Yellow	5350-5860	.535-.586	21.1-23.1	512-561
Green	4920-5350	.492-.535	19.4-21.1	561-610
Blue	4220-4920	.422-.492	16.6-19.4	610-711
Violet	4000-4220	.400-.422	15.7-16.6	711-750

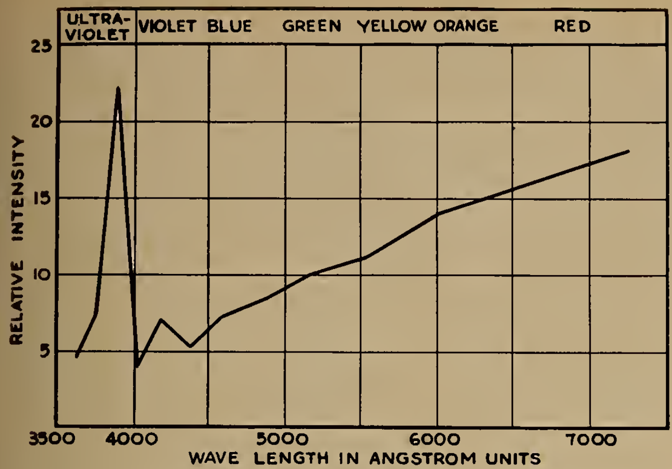


FIGURE 3

Spectral energy distribution curve, "National" SRA carbon arc: 12 mm. positive, 8 mm. negative; 30 amps., 58 volts d.c. at the arc.

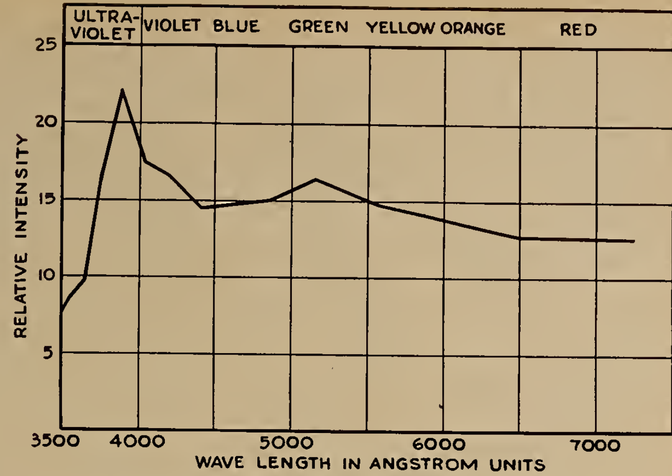


FIGURE 4

Spectral energy distribution curve, "National" Suprex carbon arc: 7 mm. positive, 6 mm. negative; 50 amps., 36 volts d.c. at the arc.

the near ultra-violet throughout the visual range of the spectrum. The intensity of radiation for any given wave-length on the Angstrom Unit scale is shown by the vertical height of the curve at that point.

Both curves were made at the normal operating currents and voltages for these two types of arcs as used for motion picture projection, namely, 30 amperes and 58 volts for the 12 mm. x 8 mm. SRA arc, and 50 amperes and 36 volts for the 7 mm. x 6 mm. Suprex arc. The arc wattage for both of these light sources is practically the same, namely, 1740 watts for the SRA arc and 1800 watts for the Suprex arc.

It is possible, therefore, to make some very interesting comparisons between these two light sources by means of these spectral energy distribution curves. The curve for the SRA low-intensity arc shows clearly the greatest amount of energy is concentrated in the yellow, orange and red end of the spectrum, with less energy in the violet, blue and green, and, further, that the distribution of this energy varies in increasing quantities throughout the visual spectrum (4,000 to 7,000 AU) as indicated by the shape of the curve.

The curve of the Suprex high intensity arc, however, shows a much more even distribution of energy throughout the visual spectrum with considerably less energy in the orange and red than is evident in the SRA arc. This difference in energy distribution explains clearly the reason for the yellowish tint of the screen light from the low-intensity arc. It also explains the daylight quality of the Suprex arc, which is the direct result of the very even distribution of the energy and corresponds to the definition previously given for white light.

LABOR ROWS AT N. Y. WORLD'S FAIR; PROJECTION MANPOWER

Labor, firmly intrenched at the N. Y. World's Fair, has participated in some fancy jurisdictional battles over work allotments, the chief brawl being among I. A. and I.B.E.W. units. Latter group, having done the original electrical work on numerous exhibits, utilized every device to keep its men on the job when the exhibits opened to the public. I. A. units consider all exhibits as "shows," thus theatrical ventures, and insist upon jurisdiction.

Many such differences existed right up to opening day of Fair. Moreover, the two I. A. stagehand units in Brooklyn and N. Y. staged a few tiffs themselves relative to transport, erection and handling of scenery.

N. Y. pojectionist union Local 306 expects to have at least 100 men working on the Fair grounds. General rule is one man to each projector operating, whether 35 or 16 mm., while the automatic continuous projectors are assigned one man to a group of about eight machines. Many projection manpower details not yet settled.

I. A. Coast Autonomy Battle; N. Y. City Strike Illegal, Opines D. of J.; Receiver for St. Louis Union

DEVELOPMENTS on the labor front were many and interesting during the past month. In Hollywood, the so-called autonomy group within Local 37 gave battle on a wide front to the I. A. General Office in an effort to oust the latter from control of the Union. I. A. recently granted local autonomy to Local 37, only to again assume control a few weeks later after ousting the elected officers.

I. A. contends that its Local 37 opponents are dominated by Communists, a charge that is now being investigated by the Dies Committee. The autonomy group, in a series of sensational affidavits filed in the courts, contends that I. A. seeks control of the studio unions as a means of extending its centralized power. Peace seemed assured at one stage of the proceedings when I. A. agreed to restore autonomy and permit direct negotiation on scales and conditions between Local 37 and the producers, with the proviso, however, that the I. A. drive for the expulsion of "subversive" influences within Local 37 would not cease. The proposed peace pact blew up in the face of a series of demands by the autonomy group.

The latest development in the studio mess was the announcement by the autonomy group that it would campaign to have all I. A. studio members refuse to pay dues to the International—pending withdrawal of I. A. officials. The General Office scoffed at this announcement and reiterated its determination to "clean up" the Coast situation.

Further complicating the situation was the refusal of the producers to negotiate with I. A. Coast unions under the terms of the Basic Wage Agreement, formulated some years ago. The General Office forced the producers to capitulate by wiring a stand-by strike order to all affiliated locals. Negotiations are expected to begin shortly.

● D. of J. Intervenes

The conflict between the General Office and Local 37 has been the topic of almost daily releases over press association wires. This fact, plus developments in the N. Y. Local 306 strike against the film exchanges, claimed the attention of the Department of Justice, which announced that it would investigate all angles of the I. A. situation to determine whether there had been any violation of the anti-trust statutes—the theory evi-

dently being that I. A. activities were impeding interstate commerce.

The strike by Local 306 in New York City against the major film exchanges and laboratories came to an abrupt end upon announcement by the Department of Justice that it considered illegal the methods employed by the Union in attempting to force distributors to refuse film service to 75 theatres which use other than 306 projectionists. Precisely this result was forecast in I. P. last month.

Although failing in its main objective, Local 306 succeeded in obtaining a substantial wage increase for its exchange projectionists, retroactive to Sept. 1, 1938 and running until Sept. 1, 1940.

In St. Louis, the Circuit Court, acting upon a petition signed by 66 members of Local 143, appointed a receiver for the Union and issued a sweeping injunction barring all interference by the I. A. General Office in the operation of the Union and in control over Local members. The Union has been under I. A. supervision for several years.

The Local 143 receivership, similar in many respects to the Local 306 receivership of six years ago which was speedily voided by a higher court, is notable in that the receiver named is distinguished chiefly for his anti-union attitude and activities in the industrial concern which he heads.

Pittsburgh Local 171 has voted to retain General Office supervision over its affairs for the next two years.

Mass. 'Safety' Bill Killed By Union Opposition

The death blow to Mass. Senate Bill 241, relating to a projector "safety" device that has worried New England projectionists, was delivered by Thad Barrows, president of Boston Local 182, at a recent legislative hearing. Similar bills still are being studied by legislative committees in Maine and in New Hampshire.

In opposing the bill, a description of which is appended hereto, Barrows pointed out that the device mentioned therein was not patented, seemingly because of its close similarity to another device known as the Coda, and that in his opinion it not only did not afford the protection claimed but in fact introduced additional hazards to the projection process. Barrow stated that the record of the Mass. Dept. of Public Safety in supervising projection apparatus in itself rendered unnecessary use of the device.

Pertinent portions of the bill follow:

No cinematograph or other apparatus, hereinafter in this section called tbe machine, involving the use of an inflammable film or projection record, shall be used for the purpose of exhibiting such film or record in any place where an audience or collection of persons is assembled to witness said exhibition unles tbe machine is equipped or fitted with a safety control device that will automatically interpose an opaque heat-resisting shutter or guard between the projection light and said film or projection record instantaneously on the breaking of the said film or record, due to burning or other cause on the stopping of the movement of said film or record through the path of said light, or on any interruption of or change of the regular feed movement of said film or record through said path of light from that required by the regular operation of the machine due either to fire or defect in said film or record or in the operating mechanism of the machine, or from other causes, and that will instantly shut off the motive power of tbe machine and stop its moving mechanism.

Said safety control device shall be free from a multiplicity of contact controls in order to reduce congestion of parts with consequent possibility of mishap and confusion and shall, in the case of a picture projection machine or device, comprise a single control unit operated by the moving film or record and, in the case of a combined picture projection and sound reproducing machine, comprise not more than two such control units, one for the picture projection mechanism and the other for the sound mechanism.

Important Notice!

The management of INTERNATIONAL PROJECTIONIST desires to acquaint its readers and advertisers with the fact that this paper, unlike certain other publications, holds not one share of stock of, nor has any special interest in, any company manufacturing motion picture theatre equipment. I. P. accepts advertisements on a cash basis only, and it believes that the acceptance of stock or any remuneration other than cash in payment for advertising is unfair to its readers and, doubly so, to its advertisers.

Also, the ownership of I. P. is vested solely in two persons who are active in its operation, and it does not owe a nickel to any bank or manufacturing company.

H.T. Matthews Heads Motiograph, Succeeding J. B. Kleckner

H. T. Matthews has been named president and general manager of Motiograph, Inc., succeeding Joseph B. Kleckner, who resigned recently. Matthews has been secretary of Motiograph for the past two years.

Matthews stated that the management shift would not involve any alteration of the company's policies or operation. "We contemplate no other executive changes, either in the sales or manufacturing departments; and there will be no major change in common holdings of the company," he said.

ALTEC SERVICE PACTS

Neighborhood Theatres, Inc., of Richmond, Va., has signed for Altec service for all its 21 theatres. The Rome Circuit, Baltimore, Md., has also signed with Altec for 14 theatres.

Proper Viewing of Motion Pictures

By *BEN SCHLANGER*

NOTED THEATRE ARCHITECT, NEW YORK CITY

THE problem of proper viewing of the motion picture is a more complex one than is supposed on first thought. The more common seeing problems of everyday life have only recently been dealt with fairly successfully, and the work done in this field can be used as a guide in the motion picture viewing problem. Yet this problem differs from the common seeing problem inasmuch as a great number of people view a given motion picture at one time, while the common seeing problems involve usually only one person in a reading or working task.

Actually, there is a limited number of people who can properly see a screen image at one time. This number will vary with the size and lighting of the screen image and the efficiency of the seating arrangement. For example, an incorrectly sized and illuminated screen image and an inefficient seating arrangement will greatly reduce the number of people who can properly see the picture. And so there may be a thousand seats in a given theatre, but only half that amount may afford satisfactory viewing of the picture.

The absolute maximum number of people who can properly see a motion picture image at one time is controlled by the maximum advisable magnification of the 35 mm. film and the amount of screen illumination available. The Projection Practice Committee of the S.M.P.E. conducted a study survey of about 600 theatres which indicated this maximum to be about 2,000 people.

● Good Viewing Maximum

The important problem is not so much to solve how large a capacity can be developed in any theatre as it is to arrange for a thousand good seeing positions where a thousand seats are installed, if such a thing be possible. The average theatre presents no such favorable circumstances. In many instances, as much as thirty per cent or more of the seating capacity affords poor seeing conditions.

Poor seeing conditions may constitute physical discomfort or fatigue, the in-

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The IP EDITORIAL PAGE

Vol. 14, No. 4 APRIL 1939

Fire Prevention in the Theatre Non-Existent

Elsewhere in this issue there appears an abstract of an extremely interesting address delivered recently by Mr. Alfred F. Sulzer, vice-president of Eastman Kodak Company, before the Greater New York Safety Council. Mr. Sulzer's topic is film fire prevention in the motion picture industry; and we can think of no subject of more absorbing interest to motion picture projectionists than this; nor do we know of anybody more eminently qualified to discuss this topic than Mr. Sulzer. A careful reading of this article (which course we recommend to every projectionist) reveals certain statements which seem to call for a bit of editorial comment.

Nobody can deny that the motion picture industry and the various underwriting companies have done a magnificent job in overseeing the handling of film. Every step of the journey of film stock, from manufacturer to delivery at the theatre, is hedged with safeguards such as are unsurpassed in any other industry. Studios and laboratories handle film with extreme care born out of a great respect for the potential powers for damage inherent in such a product. Film exchanges have compiled such a formidable record for safe handling of film as to render superfluous any extended comment thereon. But what about the handling of film in theatres?

Mr. Sulzer refers to "the practical absence of fires in motion picture theatres"; and he comments on the "negligible number of fires (in the film industry) as compared with the number attributable to any other cause." Both statements are beyond criticism—if we fix firmly in our minds the fact that Mr. Sulzer speaks from the viewpoint of a manufacturer the extensive distribution of whose product is vitally dependent upon rigid adherence to the rules of safety.

We in the projection field look upon statistics of comparable performances much less complacently than do other industry workers; and we would be willing to accept something a bit short of perfection. "Comparable" looms as a gigantic word to us when we recall the hundreds of projection room fires which occurred during 1938 and the score or more projectionists who lost their lives as a result thereof. True, included among the "hundreds" of such fires were numerous small blazes that were confined to a few seconds duration in the projector head; but these circumstances can neither erase them from the tally sheet nor minimize their potential power to kill humans and destroy property. We in the theatre will instinctively ask ourselves: "Just what do all these elaborate safety measures mean to us in the theatre?" A moment's sober reflection must inevitably bring the answer: "Nothing".

Where the degree of precaution should be highest in the theatre, it actually is the lowest. Strange it is that the moment a print is developed to a theatre the whole elaborate safety system that has been so painstakingly built up collapses. Oh, yes, we are aware of the work of national, state and local regulatory bodies in throwing safeguards around moviegoers; we are familiar with the various codes relating to various types of structures, forms of construction, placement of exits, *etc.* But none of these activities goes to the core of the problem—which is the motion picture projector itself and its state of repair or disrepair. Certainly there is a streak of carelessness in all of us, particularly when executing familiar tasks; but the number of theatre film fires due to projectionist negligence is as nothing compared with the number of fires occasioned by worn and defective equipment—setting aside all consideration of the screen image.

On a recent trip through eight states we had occasion to visit many projection rooms, wherein we examined carefully the projectors. The condition of some of these projectors was, and undoubtedly still is, such as to defy description—and if we were to essay this task, we should be accused of gross exaggeration. But if one can imagine taped moving parts! one can get an idea of the long list of lesser shortcomings. Worn sprocket teeth were commonplace, and so worn as to occasion wonder that they could possibly engage the film. But we're not listing projector defects herein; we're trying to make a point. What is it? Just this: why not supervision by the underwriters or some national regulatory body over the physical condition of the projector?

Projectionists and a relatively few progressive managers have for years preached the doctrine of projector repair and replacement, not only on the score of safety but also because of pride in a good screen image. But the efforts of this group of sensible people have gone for naught insofar as impressing the great majority of managers is concerned. The latter will toe the mark only if forced to do so. That force can come only from one source, already mentioned.

Projectionists should continue to battle strenuously for repairs and for replacement parts. If the boss has little regard for the quality of the screen image, he should be reminded that the projectionist has more than a slight interest in his personal safety. Without this continuing struggle by projectionists to effect improvement in equipment repairs and replacements, the list of film fire tragedies would be many times its present total. Projectionists should keep eternally after the boss on this topic, blasting away at every opportunity. O. K., let it be for purely selfish reasons.

Yes, we agree with Mr. Sulzer that the fire prevention record of the motion picture industry is indeed a remarkable one—that is, up to the point of delivery of the film to theatres. Beyond this point fire prevention not only does not exist but is not even considered. And it never

(Continued at foot of next page)

Proper Viewing of Motion Pictures

(*Continued from page* 18)

ability to discern important detail images on the picture, or the appearance of a distorted screen image. These are the definite undesirable seeing conditions which may exist; but there are additional poor seeing conditions which may be considered less definite or more difficult to discern.

These latter conditions deal with the relationship of the appearance of the screen image to the appearance of the physical surroundings of the screen, and the lighting effect surrounding the screen image. Although the latter conditions are not seemingly objectionable when incorrectly treated, there would be more artistic and less fatiguing effects obtained if the treatment were correct, and therefore prove to add greatly to the general dramatic effectiveness of the screen presentation.

Yet it is important at this time to at least correct the more definite and objectionable poor seeing conditions, and hope that further improvements will follow soon. The first of the important seeing conditions to be considered is that of the ability of the viewer to see the entire picture without having to constantly shift or raise the position of his head to overcome the obstruction of the view of the picture caused by the person seated in front of him. The expression "sight-lines" is often wrongly used in connection with this problem, because this expression covers another seeing consideration, that of the viewing angle. And so this first consideration should be thought of separately as the "screen obstruction problem."

Conventional Floor Slope

The older and common method of dealing with this obstruction problem in the past has been to rely upon sloping the orchestra floor downward toward the screen supposedly so that any person would be seated high enough above the person in front so that the person in front would not cover the screen image, partially or wholly. This method proves satisfactory in theatres having no more than approximately eighteen rows of seats in depth, but does not work out so well in theatres of greater depth, because the amount that the floor would have to slope would become too excessive for practical use.

For example, a pitch from one row back to another row in the first few rows near the screen for obtaining proper clearances may have to be about ½ inch, whereas the pitch from the 30th to the 31st row may have to be about 4 inches. This need for a greater rise per row as the number of rows from the screen becomes greater necessitates the excessive floor pitches.

For want of a better solution or lack of study, theatre designers in the past followed the least line of resistance by avoiding the highly impractical steep floor pitches and therefore used a compromise floor slope which would not be too great. To make matters worse, they found a good excuse for the compromise floor slope by claiming that "second-row vision" was achieved. Many of the well known theatre architects still are designing new theatres in which the floor slope and seating arrangement provide for "second-row vision." The full meaning of this so called "second-row vision" should be made clear to you, and then you should use your own judgment as to whether or not you will consider it a solution to the screen obstruction problem.

The technical explanation of the term "second-row vision" is as follows: A person seated in a given seat could see the entire screen over the head of a person seated directly in front but two rows ahead. Therefore, if there is no person seated directly in front and in the row immediately ahead, this condition should prove satisfactory.

But, fortunately, for the exhibitor, and unfortunately in the case of this seeing solution, there is usually somebody seated in the row immediately ahead and directly in front. Then, under such conditions, how does a person manage to see the screen when there is someone seated immediately in front? To see the picture, you will find the viewer hugging up against one of the arm blocks of the chair and cocking his head to one side so that the head of the person in front will not be in the way. And then if a person in any of the rows ahead decides to move, everybody in the line has to shift again to gain a view of the screen, and in the shifting time miss some of the action of the picture and of course break the continuity.

If the viewer wants to sit comfortably with the bulk of his weight centered over the seat of the chair and remain in any desired position without having to shift his position constantly, he just won't see the screen.

Reversed Slope Plan

There is no doubt that seeing a motion picture should prove more enjoyable if the viewer does not constantly have to maneuver the position of his head and body to gain a view of the screen. New methods of floor slope design and seating arrangement make it possible to achieve "first-row vision," which is meant to indicate that the viewer can, regardless of the posture he assumes, at all times see the screen over the head of the person immediately in front and in the row ahead as well as over the heads of persons in all other rows.

Every projectionist should observe the viewing conditions in his theatre and report to his superior the existence of faulty conditions, because such conditions can be rectified *even in existing structures.* The objectionable screen obstruction here discussed is to be found chiefly in the seating area of the main floor and upper levels of seating, starting with about the twelfth row from the screen, and in the center section of seats covering a width which would be equal to about the width of the screen. Since the seating area described is the choice seating area for viewing motion pictures, it is important that the obstruc-

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Editorial

(*Continued from preceding page*)

will be until such time as force is employed to whip into line those managers who run their projectors to death and thus cheat the paying audience and threaten their very lives.

The entire motion picture industry is concerned in this matter, because it would require only a couple of "unlucky breaks", a very few "unpleasant incidents", to cause the regulatory bodies to swing into action and revise the whole setup relating to the handling of film. At the present moment fire prevention in theatre projection rooms is a joke; it doesn't exist. We believe that the solution to this problem lies in voiding the discretionary powers over projection equipment now lodged in the managers (most of whom don't know the difference between a sprocket and a lens holder) and transferring it to a national regulatory body. Then, and then only, will we get action on this matter.

Fire prevention in the theatre today hangs by the slender thread of constant projectionist insistence and dogged persistence. May these efforts never cease.

tion problem be properly disposed of for these seats.

In a later article I will discuss other problems of proper seeing of motion pictures.

G.T.E. 1st QUARTER PROFIT

General Theatres Equipment Corp. and subsidiary companies, excluding Cinema Building Corp., J. M. Wall Machine Co., Inc., and Zephyr Shaver Corp., report consolidated net profit, after provision for depreciation and estimated normal Federal income tax, for the three months ended March 31 of $145,544. This compares with consolidated net profit of $120,265 for the corresponding period last year.

EPOCH OF PROGRESS IN FILM FIRE PREVENTION

(*Continued from page* 10)

of a prize fight. Progress was at first slow, but, by the late nineties and early nineteen hundreds, motion picture shows—often referred to as nickelodeons —were becoming more common. Production was low, however, and the quantities of film on hand were necessarily small.

These early films were short. A show usually consisted of one, or at most two, subjects. The show lasted twenty to thirty minutes. Twenty to thirty shows were put on daily; but the seating capacity of the theatres, many of which were remodeled stores, usually did not exceed one hundred.

Because of the constantly increasing use of motion picture film, which is not backed or interleaved with paper, and because of some serious fires that ocurred in theatres and exchanges, the Eastman Kodak Co. became vitally interested in the problem of fire prevention.

In 1906 Kodak began experimenting with cellulose acetate, which has the same transparent properties as cellulose nitrate and in addition is no more inflammable than paper, wood, or many other forms of ordinary cellulose. In addition to its lower inflammability, cellulose acetate will not decompose readily when heated; and, except for carbon monoxide, it does not give off toxic gases when it burns. No more carbon monoxide is released from cellulose acetate when it is burned in a limited air supply than is given off by equal quantities of ordinary cellulose, such as paper or wood.

● **Acetate Film Unsuitable**

In 1909 Eastman had developed cellulose acetate to a point where the Company felt it could be substituted for nitrocellulose in motion picture film. To give effect to this development, Mr. Eastman arranged a meeting with the leaders of the motion picture producing companies. Because the advantages of the new film were obvious to all, little argument was needed to reach an agreement whereby only cellulose-acetate film was to be supplied by the Company thereafter.

Experience demonstrated, however,

that acetate film was not as strong mechanically as nitrocellulose film and that it became brittle with use. Difficulty in the projection of the acetate film was experienced partly because of the inferior quality of the film but also because of the inferior projection equipment of that day and the rough handling to which the film was subjected.

Although some improvements ensued in film, in projection equipment, and in handling, the motion picture producers asked in 1911 to be released from their agreement to use only cellulose-acetate film. Thus, in less than two years, the Eastman first attempt to substitute slow-burning cellulose-acetate film for nitrocellulose film came to an end. This attempt failed, not because of lack of co-operation on the part of the motion picture producers, but because of the failure of the cellulose-acetate film to perform satisfactorily under the conditions to which it was subjected.

The period from 1911 to 1922 was one of research, education, and co-operation: research in methods of making the production, distribution, and exhibition of motion pictures safe to the public and the workers involved; education of everyone involved in these activities, including not only the industries themselves but also the fire departments, transportation companies, and public officials, local, state, and national; and, finally, complete co-operation which resulted from these research and educational undertakings.

With the return in 1911 to the production and use of nitrocellulose film for the motion picture industry, Eastman co-operated wholeheartedly with the motion picture producers, the national and local boards of underwriters, the National Fire Protection Association, and the various governmental bureaus and administrators, in the development of devices and methods to control the fire hazard in the production, distribution, and use, of cellulose-nitrate film for motion pictures.

Although in a period of five years—1912 to 1917—the reports of the N. Y. City Fire Dept. show that film was the cause of only 12/100ths of one per cent of the number of fires in N. Y. City, and 28/100ths of one per cent of the losses by fire, the potential hazard in the use of the film was realized. As a first official step, ordinances were passed, at the instigation of the boards of fire underwriters, to make the projection of motion pictures in the theatres safe for the public.

● U. S. Government Survey

Following the Ferguson Building fire in Pittsburgh on Sept. 7, 1909, the U. S. Geological Survey made a thorough investigation to determine the probable causes. From this investigation, and from laboratory tests, it was concluded that the explosion accompanying that fire was caused by the ignition of gases generated under pressure in a closed, unvented vault in which a quantity of nitrocellulose film decomposed after being ignited by the breaking of an electric light bulb. This explosion did not occur in the vault, but the gases which escaped into an adjoining room formed an explosive mixture with the air of the room and were ignited by a fire burning outside the vault.

The laboratory tests made at that time confirmed these conclusions and proved that nitrocellulose film is not explosive; and proved, furthermore, that the gases generated by film decomposition at atmospheric pressure are of a low inflammability, but that, if the film decomposes under pressure, the gases gener-

ated, when properly diluted by air, are explosive.

The results of these tests were given wide circulation, and ordinances were enacted, in practically all of the major cities, requiring the projection rooms in motion picture theatres to be amply vented to the open air and to be completely isolated from the theatre auditorium. These precautions and other restrictions—plus education as to the volume of film and its hazards—are largely responsible for the practical absence of fires in motion picture theatres.

Another source of hazard lay in the wornout, obsolete, or discarded film. With the greatly increased use of motion pictures and with longer subjects, this obsolete film piled up rapidly in the exchanges. In 1918, Eastman inaugurated the plan of purchasing this discarded film, for recovery of its constituent materials for non-photographic purposes. The film was, and still is, collected and shipped to Kodak Park, Rochester, and to other responsible converters, thus removing one of the greatest sources of fire hazards in the exchanges. In addition, safe methods were devised for handling this scrap, and these were made available to others who wished to carry on the recovery of scrap film as a business, with safety to property and life.

Despite the fact that the number of fires and losses attributable to nitrocellulose film continued small in comparison with other causes, such as gasoline, matches, smoking, and carelessness, agitation against the use of nitrocellulose film continued.

In 1915 the committee on explosives and combustibles of the National Fire Protection Association, in co-operation with the N. Y. City Fire Department and the Universal Film Co., conducted a test at Fort Lee, N. J. by burning a large quantity of discarded motion picture film in a vault which, though properly vented, was not equipped with automatic sprinklers.

This test was very spectacular. No explosion accompanied the fire, but the heat was so intense that a giant torchlike blast of flame shot horizontally out of the vault vent for many feet. Numerous tests which had been made by Eastman in its work of protecting its employees and its own property from the hazards of film fires, had demonstrated, previous to the Fort Lee tests, that properly arranged sprinklers will control film fires.

Immediately following the Fort Lee tests, the Eastman Company, believing that the severity of fires under conditions of the Fort Lee tests could be greatly lessened and could be controlled, ran a series of tests in 1915 and 1916 to determine the inflammability of film, the protective effectiveness of water in varying quantities from properly arranged sprinklers, and the protective effectiveness of various methods of packaging and storing motion picture film.

In the Eastman tests, conditions as

to volume and arrangement of film were equal to or more severe than the conditions in the Fort Lee tests. These tests, together with earlier tests run by the Company, proved conclusively that, with properly constructed and vented vaults, film fires can be readily extinguished by sprinklers, and, in addition, decomposition can be prevented from communicating to other films in the same storage racks. These tests also proved that, in properly vented vaults, sprinklers will cool the liberated gases so that explosion, or even ignition, of liberated gases is improbable.

These tests were witnessed by officials of the N. Y. City Fire Dept. and also by representatives of the underwriters and insurance companies. The results did much to convince these people that film fires in vaults can be controlled by automatic sprinklers, with proper venting and with proper limitation of quantity stored; and also that the safe storage of large quantities of film is possible if proper precautions are taken.

While the Eastman Co. was experimenting with methods of fire prevention for nitrocellulose film, the inspection department of the Associated Factory Mutual Fire Insurance Companies was carrying on similar experiments with pyroxylin plastics, commonly known as Celluloid. A comprehensive report of these tests was published in 1916. Pyroxylin contains nitrocellulose similar to that used in motion picture film. The findings in this report were in agreement with the findings of the U. S. Geological Survey in the investigation of the Ferguson Building fire in Pittsburgh. This latter report, however, included definite specifications for limitation of storage-vault capacity and for adequate venting and sprinkling.

In 1919, the N.F.P.A.'s committee on explosives recommended a similar code, or specification, for the storage of cellulose-nitrate film. These reports, and those of the Eastman experiments in the same years, dealt with the fundamentals, and have formed the basis, first, for fire underwriters' rulings, and, later, for laws and ordinances governing the transportation, storage, and handling of all nitrocellulose motion picture film.

From 1916 to 1919, Eastman prepared a series of booklets entitled, "Suggestions on Fire Prevention." The first booklet dealt with automatic sprinklers; the second, with housekeeping; the third with motion picture film, its characteristics and hazards; and the fourth with the results of the tests on motion picture film fires in vaults. Arrangements were made with the motion picture producers to make these booklets available to all persons in the industry responsible for the production, processing, handling, and storage, of film. These booklets, except one describing the tests, were written in plain, non-technical language, so that their message could be readily understood by the non-technical employees in the industry.

● Field Educational Work

In addition to this prepared material, the Eastman offer to send out experts to all exchanges to inspect the exchanges and instruct the managers in proper fire-prevention methods was accepted by the motion picture producers. Six men were specially trained for this work and covered the four hundred exchanges in the U. S. and Canada. Formal and very complete reports of these inspections were forwarded to the exchange managers and also to the officials at the headquarters of the companies owning the exchanges.

Following the first inspections, the Eastman Company, collaborating with the Fire Underwriters and with various government agencies, drew up plans and specifications for film exchange buildings. These plans and specifications were so prepared that they could be readily adapted to local conditions, and they were made available to motion picture producers and to others who wished to build new film exchanges or to rehabilitate existing ones. Eastman also provided a consulting service for the producers in this work.

Follow-up inspections showed that conditions had materially improved, indicating that, if those vitally interested in the problem of fire prevention are informed, effective co-operation is pos-

sible, This work of inspection and consultation was carried on by Eastman until 1922, when it was turned over to the newly organized M.P.P.D.A. The best evidence that that organization has successfully carried on the work is to be found in the comparative absence of exchange and theatre fires, even with the constantly increasing volume of film produced and handled.

Beginning in 1922 and continuing up to the present time, we have had a long period of consolidation of the progress made and of assimilation of the information developed by experience and experimentation. Although—as has been pointed out—the number of fires and the amount of fire loss caused by film, or in which film became involved, had been small, compared with numbers and losses from other causes, there had been a number of spectacular fires.

● Proposed Nitro Ban

In spite of the fact that investigations following these fires showed that, in general, known preventive measures had not been properly applied, there were demands periodically to outlaw the use of nitrocellulose film. In 1919, at Ottawa, the resolutions committee of N.F.P.A. offered the following resolution: "The universal adoption and exclusive use of slow-burning motion picture film with national, provincial, state and local legislation to prevent the continued manufacture and distribution of material having the hazardous properties of gun cotton stock now commonly employed."

This was Item 10 in a series of eleven items in the resolutions proposed by the committee. Item 10 caused more discussion than all the other ten items in the proposed resolutions, combined. There was a decided difference of opinion; but, because of the extensive laboratory tests and practical full-scale tests that had been carried on to determine the nature and hazards of cellulose-nitrate film, and because of the demonstrated effectiveness of methods of control, the great preponderance of opinion favored regulation of use rather than imposing the impractical alternative in Item 10 on the great and growing industry of production and exhibition of motion pictures. The resolutions, when adopted, formed the platform for the year, and were used as the basis of insurance-rate rulings and requirements and for legislation to make them effective.

● Acetate Film Unsuitable

Experience with cellulose-acetate film for commercial motion pictures in the years 1909 to 1911 had demonstrated that it was entirely unsatisfactory. Progress had been made in improving its wearing qualities, but in 1919 it still was far behind nitrocellulose film in this respect.

Legislation in practically all communities had been enacted to make the exhibition of nitrocellulose film safe for the public. The conditions in the exchanges had been improved, and the Eastman Co., at the time of the Ottawa meeting, was preparing to send out experts to help the motion picture producers to improve still further the conditions in the exchanges. Tests by government agencies and by others had proved that nitrocellulose film is not explosive—as we have pointed out—and records proved that the number of fires attributable to film was negligible compared with the number attributable to any other cause.

All of these facts, and others, were brought out in the discussion of Item 10 of the 1919 resolutions. As a result, the resolutions as finally adopted included a revised Item 10, reading as follows: "That the use of motion picture projection machines without a standard booth ventilated to the outside of the building, in churches, schools, clubs, hospitals and homes, be prohibited unless the film used is of the slow-burning type and that state and municipal laws and ordinances be adopted regulating motion picture ex-

changes, tending toward the ultimate end that motion picture films of the nitrocellulose type be replaced when practicable by a slow-burning film."

The great majority of the membership of the N.F.P.A. is made up of men representing the insurance companies, of fire underwriters, and of public officials. Only a small number of members represent either the film manufacturers or the motion picture producers. When these facts are taken into consideration, the action taken on this resolution is convincing evidence of the enlightened co-operation which made the control of fire hazard in the motion picture industry possible.

The M.P.P.D.A. had taken up, shortly after it was organized in 1922, the educational and inspection work started by Eastman in 1919, and had accomplished much in the control of use, transportation, and handling, of nitrocellulose film.

From time to time, however, nitrocellulose film appeared in stores and found its way into use in improperly protected projectors. In addition, scrap nitrocellulose film was in some cases transported and handled in an improper manner.

Because of these difficulties, the N.F.P.A. public-information committee, in its report in 1923, proposed recommending to the states and provinces of the United States and Canada the enactment of a model law to control the use of nitrocellulose film. This model law provided for "the control of use of nitrocellulose motion picture film and for the licensing of manufacture, use, handling, disposition, and transportation of such film."

As in the case of the 1919 resolution, this proposed law was thoroughly and earnestly discussed. No one opposed the idea of regulation or the necessity for such regulation. A minority, however, felt that the Association should not pass such a recommendation, but should again go on record as supporting the early substitution of slow-burning film for nitrocellulose film for all purposes.

After much debate which again brought out the progress which had been made in the control of the fire hazard in the use of nitrocellulose film, the Association adopted unanimously the committee's proposed model law. This action and the action at Ottawa in 1919 are good examples of an association membership made up principally of persons not selfishly interested in a commercial enterprise taking constructive action to safeguard the interests and well-being of the public, instead of destructive action, which could not have been as fruitful in safeguarding the interests of all concerned.

As further evidence of the M.P.P.D.A.'s interest in the matter of public welfare, attention should be directed to its reports to the 1924 and 1925 annual meetings of the N.F.P.A.. These are progress reports giving accounts of co-operation and outstanding accomplishment. (Co-operation, I must point out again, is the thread that has run through the whole fabric.)

More thorough and more frequent inspections, co-operation with and from local fire departments, introduction of fire drills, circularization of exchanges with educational matter, sponsoring of bills for the control of use of nitrocellulose motion picture film, are some of the activities of the M.P.P.D.A. Film boards of trade were organized in many cities. These boards included in their membership both the members of the M.P.P.D.A. and of the independent companies. Thus the organized efforts in accident and fire prevention were extended to the entire industry.

This educational and inspection work has been carried on by the M.P.P.D.A. to the present day. The annual cost, although heavy, is justified by the results. The increase in volume of film handled has been enormous, and the number of persons involved in the many necessary operations has increased accordingly. The price of safety in any industry is eternal vigilance. The only guarantee that such vigilance will not slacken is to be had through a follow-up which will develop intelligent, whole-hearted co-operation from each and every member of the industry.

Naturally, this story told by the Eastman Kodak Company, in spite of effort to view it dispassionately, must needs be colored to some extent by the Company's interest in the matter. If its actions were said to be motivated by self-interest, however, it was at the very least an enlightened self-interest, and the same is no less true of the motion picture industry as a whole. As I said in my opening remarks, it is a story of accomplishment of great value to the public, made possible by one dominant factor—co-operation.

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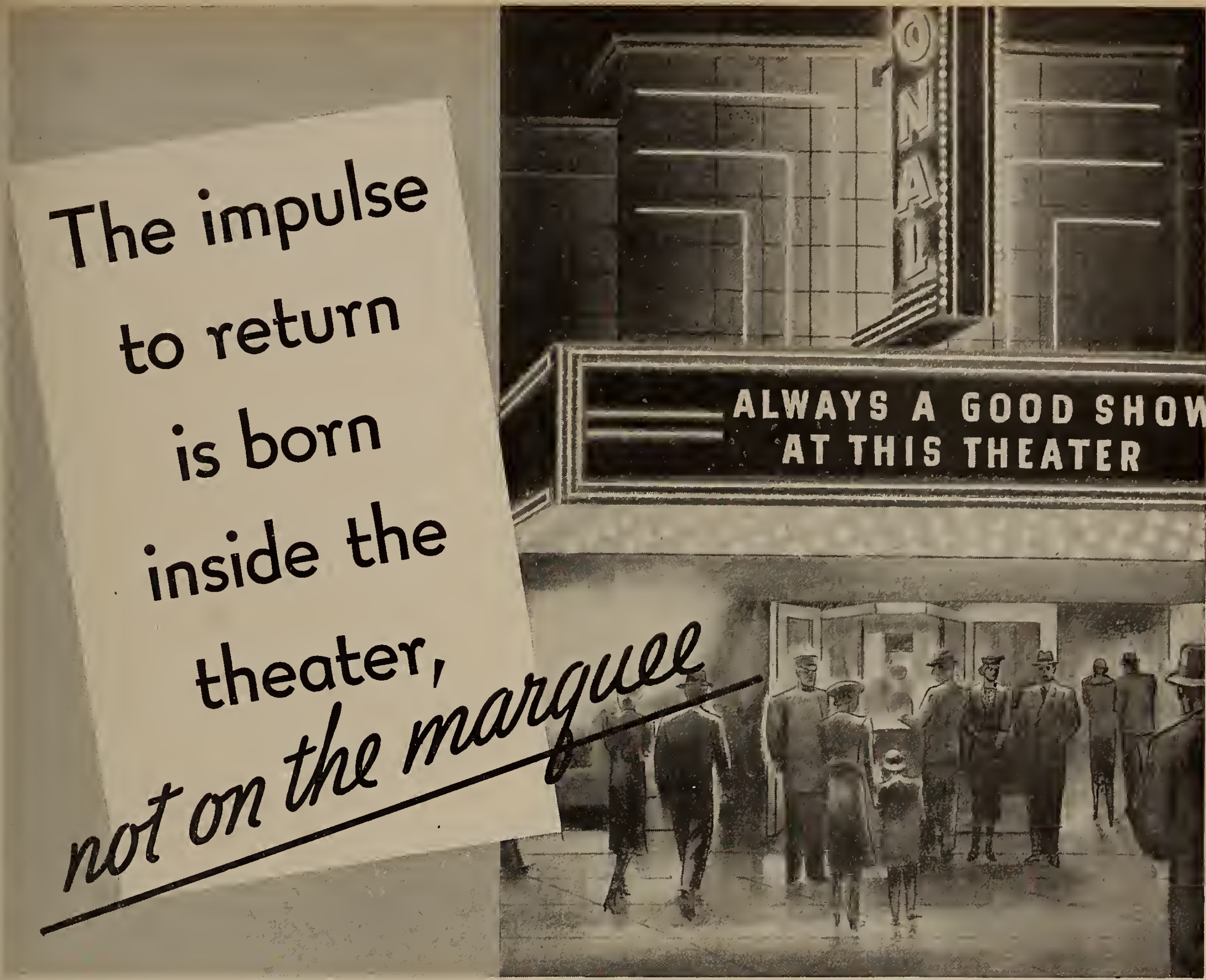

● "I dropped into the Majestic the other night. There's where I'm going after this when I want to really enjoy a show. I've never seen better theater lighting. I found my seat without stumbling and groping. My eyes didn't get tired and I figured that was because there was no sharp contrast between the screen and the walls around it. It was a color feature and I've never seen more natural color on the screen."

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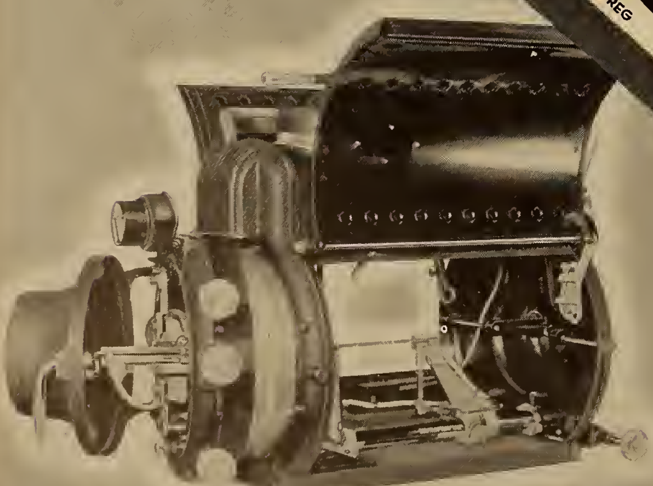

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International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

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Monthly Chat

PERIODICALLY we have commented in this space upon the constantly growing use of 16 mm. projection equipment in the professional motion picture field. We are all familiar with the many applications of such equipment in the educational and industrial fields; but the widespread use of 16 mm. units for presenting shows to which admission is charged would surprise the professional projection craft.

True, most of these shows are sponsored by itinerant exhibitors who make one- or two-night stands in the less densely populated territories; but it would be no great shock to this corner if the producers made available shortly 16 mm. prints of features not more than three months old (from national release date) in order to cash in on this rapidly expanding field.

Many such 16 mm. shows charge no admission, the program being made up of sponsored advertising films. In many localities, however, and particularly through the South, the traveling exhibitor pitches a tent or hires a vacant store or a hall and plays "old" feature subjects on a 10-15-20-cent admission scale. In fact, reports persist that a regular circuit of hundreds of such stands is to be established throughout the South.

This situation poses a serious problem for the established motion picture theatre—and for the projection craft. Reiteration of our previous suggestion that this matter have the close attention of the organized projection craft seems to be very much in order. We know of no more pressing current problem.

• • •

Believe it or not, we've received several letters lately suggesting that the Projection Advisory Council become active again. Anybody saying anything?

• • •

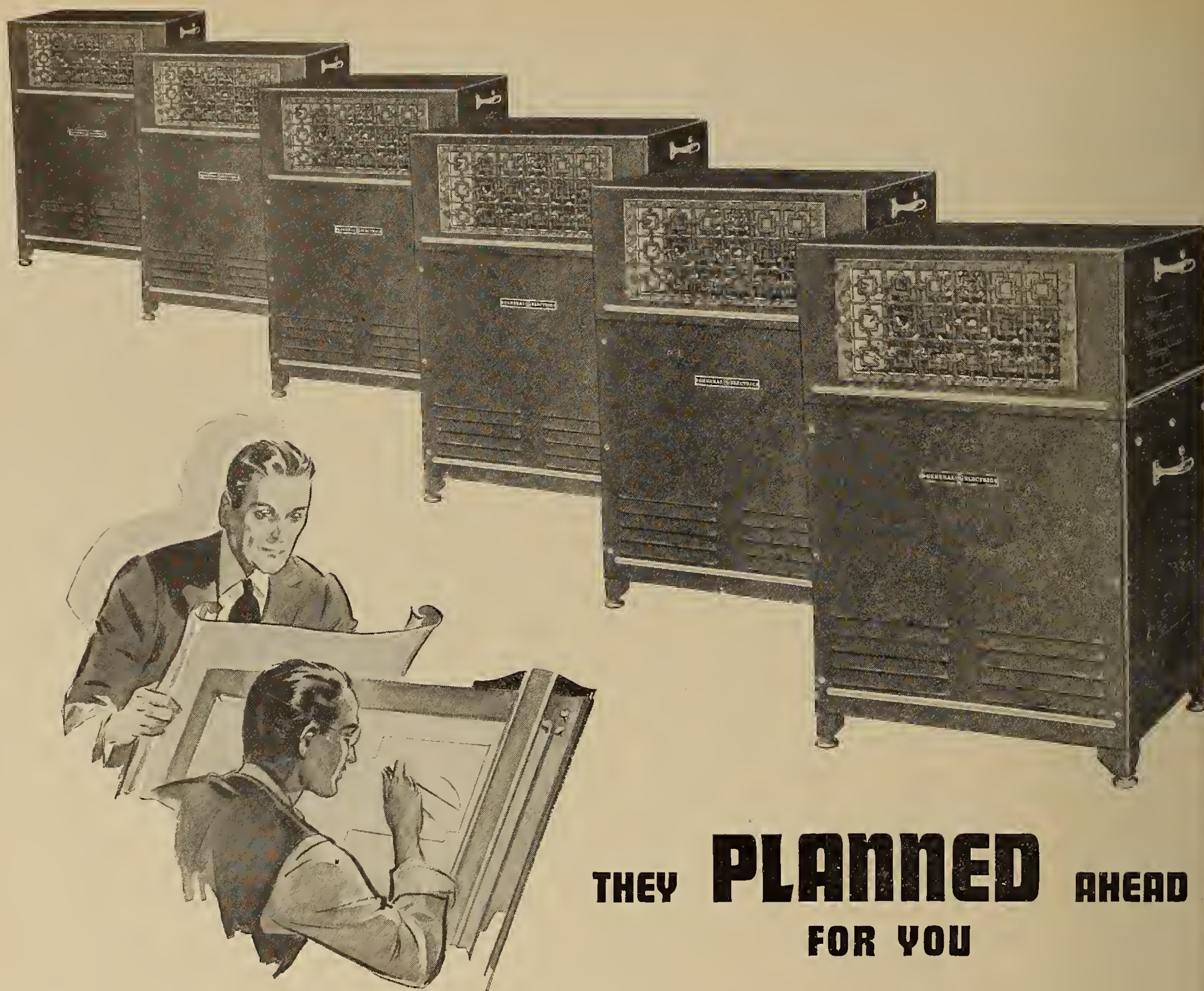
Technicolor Corp. does some plain and fancy weeping in public about the inability of many theatres to do justice to their hued prints. Privately, however, this company's efforts to improve color-projection can be summed up in one word—nothing.

• • •

Film breaks, a menace to the safety of audience and projectionist and ruinous to a good show, are piling up alarmingly, reports to circuit headquarters indicate. Whatever the cause, discretion dictates that pre-show inspection of film is the only "out" for Mr. Projectionist, with a detailed report being sent to the manager promptly.

• • •

Our British friends are hailing the mercury vapor lamp as the "greatest advance in projection since sound pictures". Mebbe so; but this will be news even to the overly-enthusiastic American sponsors of this light source.



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In 1934 a group of engineers looked into the future of the motion picture industry. They were planning a copper oxide rectifier for projection service. The foremost thought in their minds was that you fellows must be freed from the fear of frequent design changes if you are to buy the equipment you need.

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GENERAL ELECTRIC

INTERNATIONAL PROJECTIONIST

VOLUME XIV NUMBER 5

MAY 1939

The Copper—Sulphide Rectifier†

By *C. A. KOTTERMAN*

P. R. MALLORY & COMPANY, INCORPORATED

Controversial indeed is the topic of power supply for theatre projection arcs. The accompanying paper, and particularly the appended discussion, contains extremely interesting data anent one such unit, including consideration of construction, operation, degree of dependability, and life — questions bearing on which have long claimed the keen interest of projectionists.

A RECTIFIER may be defined as a device for converting alternating current into unidirectional current by mechanical, chemical, or electrical means. Probably the most common mechanical rectifier is the motor-generator set. Another familiar type is the rotary converter. All rotating mechanical rectifiers are equivalent to converting the alternator source to a d. c. generator.

Another mechanical rectifier that has wide application in the low-current field is the vibrator type, employing a tuned reed. This rectifier is used in about 90 per cent of all automobile radios, although in many cases, in this application, it acts as an inverter instead of a converter. Another form of mechanical rectifier is the mercury-jet type, wherein a jet of mercury oscillates at appropriate frequencies between contacts performing the commutation. All mechanical rectifiers depend upon physical connection and the opening of an a. c. circuit at the correct times.

For the sake of simple classification, thermionic rectifiers such as vacuum-tubes, gas-filled tubes, and mercury arcs, fall into the electrical group. The vacuum-tube rectifier employing a hot filament is a familiar example, as it is found in practically every home radio set. A less familiar type, but of wide commercial usefulness, is the mercury-arc rectifier. One form consists of a hot cathode spote on a mercury pool to which the anode current flows. In another type, a hot cathode operates in mercury vapor.

● The M-C-S Unit

A rectifier falling in the electrical class and with which the balance of this article will deal, is the magnesium-copper-sulfide dry disk, or plate, rectifier, first developed about fifteen years ago by S. Ruben. It consists of an electropositive conductor and an electronegative semi-conductor in more intimate contact than physical juxtaposition and pressure can give. The electropositive element is magnesium; the electronegative element is copper-sulfide.

The rectifier is electronic in operation, the current flowing from the sulfide element to the magnesium element. In this, the conducting direction, the voltage drop across the junction is extremely low, remaining practically constant regardless of load. In the non-conducting, or blocking direction, the resistance of the rectifying junction is quite high. Electric current flows when the magnesium is made negative with respect to the polarity of the sulfide side; and blocks the flow of electricity when made the positive side.

The magnesium-copper-sulfide rectifier is known as the non-integral type,

†J. Soc. Mot. Pict. Eng., XXXII (May 1939).

because the two components of the rectifier have a rectifying film formed between them by an electrical process. Because of the unique way in which the rectifying film is built up, it can stand overvoltage which, if it results in breakdown of the rectifying film, instantaneously heals itself without damaging the rectifier.

Any attempt to explain exactly how a contact rectifier operates usually becomes very much involved. It is beyond the scope of this article, therefore, to enter into a highly theoretical discussion of the physical principles underlying its operation. Suffice it to say that a rectifier that depends upon electronic action may be likened to a valve or gate: it opens the a. c. circuit 60 times per second when the half-cycle is of one sign, and closes the circuit when the half-cycle is of the opposite sign. Such rectifiers are all metallic, and have no moving parts, hot cathodes, glass parts, or other fragile constructional components.

The theatre projection arc affords an ideal application for the copper-sulfide rectifier. These arcs usually operate on currents varying from 50 to 65 amperes at 35 volts. These values are particularly well suited to the copper-sulfide rectifier, which is fundamentally a high-current, low-voltage type.

In order to evaluate the magnesium-copper-sulfide rectifier in terms of useful power-supply devices for projection, it will be necessary at this point to describe several fundamental facts by which the performance of the sulfide rectifier is measured.

● Performance Measurements

The first fact to establish is how much a. c. voltage will one rectifying junction block; in other words, how much a. c. voltage can be applied across the components of a junction without breaking down the insulating film between them. The magnesium-copper-sulfide rectifier will stand 3 to 3.75 volts rms. on load per junction. These are working voltages. Blocking peak voltages would be 1.4 times these values. When these values are exceeded by 15 or 20 per cent there is the possibility of breakdown, resulting in rapid deterioration of the junction if the condition causing the breakdown persists. However, as previously stated, occasional overvoltage due to line surges, *etc.*, causing momentary breakdown in the rectifying film, will not affect the normal operation of the rectifier or its life.

Closely related to the permissible volts per junction is the ratio of d. c. output voltage to a. c. input voltage. For three-phase, full-wave bridge operation it has been found that the voltage ratio of the magnesium-copper-sulfide rectifier is about 85 per cent. In the case of the rectifier for projection, this means that 44 volts a. c. are impressed across a sufficient number of junctions in series to produce 35-36 volts d. c. at the arc. Another important factor is the current ratio; that is the ratio of the d. c. output to the a. c. input. The rectifier has approximately a 120 per cent current ratio for three-phase, full-wave circuit system

Having reviewed rectifiers in general and discussed the mechanism of the contact rectifier in particular, we can now consider details of design for a rectifier power supply for the projection arc. The essential features are:

(1) Most suitable type of a. c. circuit system.

(2) Current-handling capacity of the sulfide rectifier as a function of life and operating temperature.

(3) Cooling or ventilating methods.

As most projection arc rectifier applications call for d. c. voltages varying from 35 to 50 volts, it is necessary to employ a transformer to step-down the 110- or 220-volts a. c. source to a suitable value to be used in the arc circuit.

Two basic circuits are employed with all contact rectifiers: the half-wave and full-wave bridge, single-phase or polyphase. The full-wave bridge requires twice as many rectifier elements as the half-wave for the same voltage input.

FIGURE 1

Various circuit systems used with sulphide rectifiers

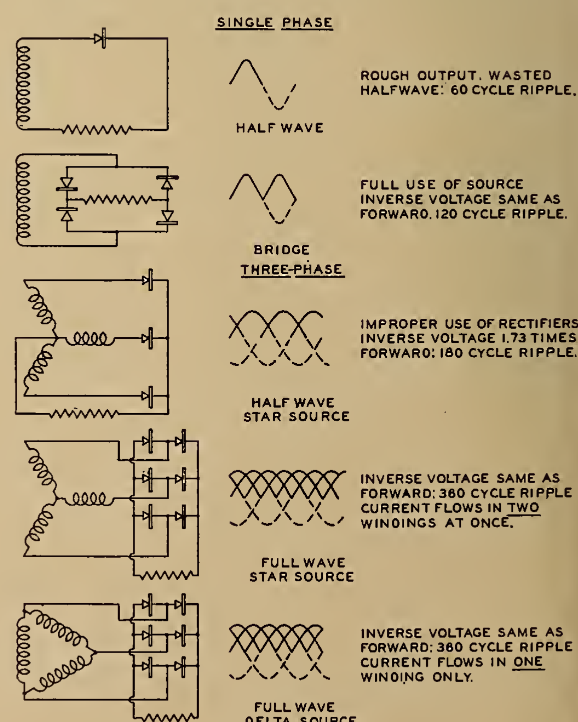


Fig. 1 shows various circuit systems.

The three-phase, full-wave bridge connection with the windings of the source delta-connected, has the lowest blocking peak voltage per element (it is the same as the forward voltage) and requires fewer junctions than some of the other polyphase systems. Because this is very desirable from an application viewpoint, this circuit is considered the best, giving, as well, a ripple six times the input frequency of 60 cycles. It may be mentioned that where filtering out the ripple is necessary, the higher its frequency the easier it is to filter.

● Operating Temperatures

All contact rectifiers are resistance devices, therefore, they generate heat when rectifying. The normal life expectancy of such a rectifier is based mainly on its operating temperature. The lower the operating temperature, the longer the life, when other operating conditions are normal. Heat generated at the junction must, therefore, be removed faster than by simple convection cooling if the rectifiers are to handle large currents such as those associated with the carbon arc.

The magnesium-copper-sulfide junction, designed for carbon arc use, having 1.7 sq. in. of rectifying area with associated radiator plate of 12¼ sq. in. of area, will handle 38 d. c. amperes per sq. in. safely and continuously. These current-densities are based on three-phase, full-wave operation.

One of the outstanding features of the copper-sulphide rectifier is the ability to withstand unusually high operating temperatures. Fig. 4 shows a life-test curve on a copper-sulphide rectifier purposely operated at temperatures considerably in excess of those encountered in the projection arc type of

rectifier. Remembering that 100°C is the temperature of boiling water, it is readily understood that a rectifier that can withstand such a temperature continuously is truly remarkable. Any other type of contact rectifier would absolutely fail at such a temperature or at even much lower temperatures.

For low current-densities per rectifying junction, where the operating temperature will never exceed 130°C, the simplest method of cooling is convection cooling. Where the rectifier is required to handle large currents, as in the projection arc application, it is necessary to employ forced draft or so-called fan cooling.

Where the rectifiers are operating at comparatively low current-densities, as in the case of the rectifier for the theatre carbon arc, a simple adaptation of some well-known cooling principles may be employed. Such an adaptation has been worked out excellently in the rectifier shown in Fig. 3. The transformer is placed at the bottom of a steel cabinet. The two banks of rectifiers (in the case of a twin arc power-supply) are supported in trays immediately above the transformer. The space around the trays is baffled to concentrate the air-flow through the cooling fins of the rectifiers.

Degree of Dependability

A propeller-type fan blade of sufficient air capacity to maintain the operating temperature of the rectifiers considerably below their maximum safe operating temperature is driven by a motor mounted at the top of the cabinet. This simple cooling arrangement draws air in from the bottom, over and around the transformer, then through the rectifier cooling-fins, with discharge at the top, providing efficient cooling in a compact assembly.

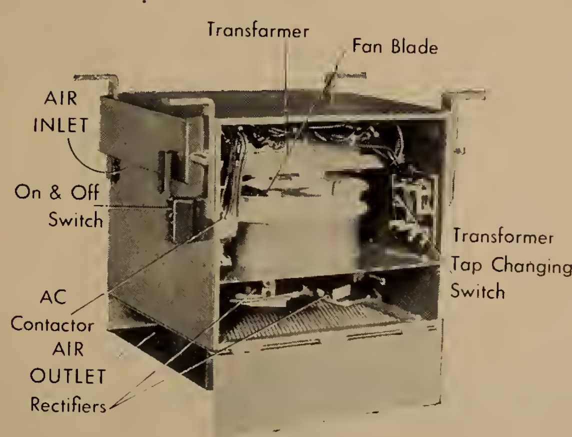


FIGURE 2

Arrangement for ventilating rectifier for large power output

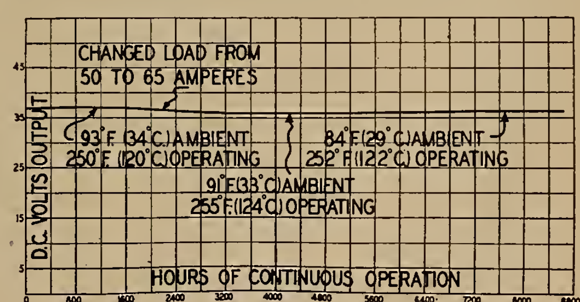
Any discussion of power-supply for projection arcs immediately raises the question of the relative merits of rotating equipment *vs.* rectifiers. Probably the most essential feature of such units for the theatre is dependability regardless of the type of source.

Rotating equipment requires periodic servicing and maintenance. The magnesium-copper-sulfide rectifier, if properly ventilated and not subjected to abnormal operating conditions, performs satisfactorily over a long period of time without any attention whatsoever. Because of the large margin of reserve capacity in this rectifier designed for theatre use, fan failure will not darken a theatre. Instances have been reported from the field where the fan associated with a copper-sulfide rectifier for theatre use had failed and could not be replaced immediately, but the rectifier carried on for days until a new fan was installed. Such operating conditions are not to be encouraged, but they go to show that in the copper-sulphide theatre rectifier there is a power-supply available requiring practically no maintenance and one that will stand considerable punishment without failure.

Naturally, the theatre owner is interested in the all-around performances of this power-supply and how long it will last. An extensive life-test has been run on the copper-sulfide rectifier employed in projection arc power-supplies. Fig. 4 shows the results of a test run on the machine shown in Fig. 3 extended to the equivalent of 10,000 hours of normal theatre operation.

FIGURE 4

Life-test of copper-sulphide rectifier designed for projection arc supply



Improvement in the technic of processing the copper-sulfide rectifier and the experience gained during the past two years in building heavy-current rectifier power-supplies such as for electroplating, delivering 3,000 d. c. amperes and upward, indicate that these improvements now being incorporated also in the projection arc rectifier will give the theatre a dependable source of power with an exceedingly long life.

FIGURE 3

Commercial form of sulphide rectifier with forced ventilation, for projection arc power supply

Discussion:

MR. GESSIN: What is the average life of the copper-sulfide rectifier?

MR. KOTTERMAN: That depends upon a number of conditions: Operating temperature for one thing, variation in load, and the type of adaptation. For theatre use, with the improved type of rectifier we are now building, we anticipate a useful life of five years

MR. CRABTREE: What is the effect of high humidity?

MR. KOTTERMAN: None. The radiating fins and the rectifying elements are clamped together on a very heavy bolt, with spring washers at either end, to maintain constant pressure regardless of contraction and expansion during operation. The assembly is vacuum-impregnated with special varnish which prevents moisture from getting into the rectifier elements.

MR. CRABTREE: Magnesium is, of course, readily oxidized.

MR. KOTTERMAN: That is one reason

(*Continued on page* 28)

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Fundamentals of Mathematics

By *GEORGE LOGAN*
SOUND DEPARTMENT, METRO-GOLDWYN-MAYER STUDIOS

This is the first section of a series of five articles on mathematics. The individual sections deal with:

Section I—Symbols, Definitions, and Square Root. Section II—Positive and Negative Numbers, Addition, Subtraction, Multiplication, and Division of Monimials.

Section III—Multiplication, Division, and Factoring of Polynomials, Ratio and Proportion. Section IV—Simultaneous Equations. Section V—Logarithms.

It will be a help if the reader digest each article as it appears, for the ideas presented in subsequent sections hinge upon an understanding of topics discussed in earlier sections. Further, it is desirable that the issues of this series be cached away after reading, as back-reference may be useful before the series is completed.

The various examples given throughout the series will be best understood if the reader will work them out on paper, duplicating, step-by-step, the solutions given in the text.

MATHEMATICS is like a favorite tool one keeps in a kit. There may not be a need for it each hour of the day, yet when a need does arise, that particular tool is indispensible.

This analogy for math well applies to vocations which are basically technical in character. All of the phases of mechanical and electrical engineering—design, manufacture, operation, and maintenance—recurrently meet up with problems which are solved by the creation and solution of equations. Mathematics is simply logic in one of its purest forms.

Modern motion picture equipment is a nice blending of mechanical and electrical principles; and a technician entrusted with the operation and maintenance of such equipment is certainly a more valuable man if he has a practical knowledge of the basic principles involved. Those physical principles are almost invariably expressible in mathematical form. So, to achieve a firm grasp on theoretical mechanics and electricity, it is imperative that one start first with groundwork in math.

It is the writer's experience—and the experience of other engineers with whom he has discussed the subject—that by far the largest proportion of problems may be solved by simple algebraic methods. Those problems requiring more involved methods are comparatively rare. As a result this series will be concerned primarily with practical algebra. Too, a familiarity with algebra is indispensible if the studious-minded technician wishes to delve further into calculation methods; so there we have another good reason for our theme.

In arithmetic, combinations of the numerals 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, are used to express quantities. Algebra uses these numerals too, but introduces also the use of alphabetical letters *a*, *b*, *c*, *d*, *e*, *f*, . . . through *z* to denote quantities. There should be no element of mystery in such alphabetical symbols, because they stand for numbers, and before a numerical answer to an algebraic expression can be found the numerical equivalents of the symbols must be substituted in the expression.

The use of alphabetical symbols in deriving and simplifying equations is advantageous because it keeps the equation in a general form. Once an equation is in a simplified general form it may be used to solve numerous *specific* examples to which the equation applies. A very good example of this is our familiar Ohm's law for direct current:

$$I = \frac{E}{R}$$

You see, this is a perfectly general equation, and it does not insist that any one of its terms have some particular value before the equation can be applied. On the contrary, the current, or voltage, or resistance may be any value; just as long as any two of these quantities are known, Ohm's law will enable us to solve for the third and unknown quantity.

Various symbols are used in algebra to indicate operations to be performed; other symbols to abbreviate words. Thus the dash line between E and R above indicates division of E by R, and the symbol = is a brief way of saying "equals". Below are the symbols most frequently encountered.

Symbol	*Definition*
$+$	"plus," or "positive"
$-$	"minus," or "negative"
$\times$	"times," or "multiplied by"
$=$	"equals"
$\div$	"divided by"
$\neq$	"does not equal"
$>$	"is larger than"
$<$	"is smaller than"
$\therefore$	"therefore"
( )	"parenthesis"
[ ]	"bracket"
{ }	"brace"
. . .	"and so on", or "and so forth"

In division, the number to be divided is called the *dividend*. The number doing the dividing is called the *divisor*. Thus in $a \div b$, *a* is the dividend, *b* is the divisor. Division may be indicated in any one of the following ways:

$$a \div b \qquad \frac{a}{b} \qquad a/b$$

And *a* multiplied by *b* may be written:

$$a \times b \qquad a.b \qquad ab$$

When you find a parenthesis, bracket, or brace fencing in an expression, perform the indicated operations on that expression first.

$$(4+2)\times 3 = 6\times 3 = 18$$
$$(4a-2a)\times 3 = 2a\times 3 = 6a$$

In other words:

$$(4+2)\times 3 \neq 4+2\times 3$$
$$(4a-2a)\times 3 \neq 4a-2a\times 3$$

When multiplication is performed the result is the *product*. When division is performed the result is the *quotient*. When addition is performed the result is the *sum*. When subtraction is performed the result is the *difference*.

If several numbers are multiplied together to form a product (and by *numbers* is meant either arithmetical numbers or alphabetical symbols which stand for arithmetical numbers), each component number, and the product of component numbers are known as *factors*. This is similar to the idea of factors in simple arithmetic. The number 8, for example, is 4×2, and 8 has as factors the numbers 4 and 2.

Consider the term 11*z*. This is a product formed by multiplying together an arithmetical number, 11, and an alphabetical symbol for a number *z*. This product therefore has as factors, 11 and *z*. When one of the factors is an arithmetical number, as in this case, that factor is known as the *coefficient* of the alphabetical symbols in the term. Thus 11 is the coefficient of *z*. Similarly, in a

term $4k$, 4 and k are the factors, and 4 is the coefficient of k.

When the coefficient is simply 1, usually it is not written, but its existence is understood. Thus $1y$ is usually written y.

If a number is multiplied a certain number of times by itself, the product obtained is called a *power* of the number. The operation of obtaining a power of a number is indicated by writing a small exponent above and to the right of the number like this: y^4.

This is read *y to the fourth*, or *the fourth power of y*. The number y is known as the *base*, 4 as the *exponent* or *index*. Writing y^4 is simply a brief way of saying:

$$1 \times y \times y \times y \times y$$

As has been stated, if an algebraic symbol is written without a coefficient, the coefficient 1 is understood to exist. That is why in interpreting the expression y^4 in detail we write:

$$1 \times y \times y \times y \times y$$

This leads up to the interpretation of a number raised to the zero power, such as:

$$b^0\text{, or, identically, } 1b^0$$

Here our exponent tells us that the unity coefficient, 1, is not multiplied by b *any* number of times, so that simply unity is the result. Hence, any number raised to the zero power becomes simply 1.

$$b^0=1$$
$$b^1=1 \times b$$
$$b^2=1 \times b \times b$$
$$b^3=1 \times b \times b \times b$$
$$b^4=1 \times b \times b \times b \times b$$

Finding the *root* of a number is a procedure inverse to that of finding the power of a number. A root is one of the equal factors of a number. The operation of finding the root of a number is indicated by the placement of a root sign over the number, as

$$\sqrt[2]{64}$$

which is read *the square root of sixty-four*. The small number nested in the root sign is called *the index of the root*. It indicates the number of equal factors taken. For example:

$$\sqrt[2]{64}=8, \text{ for } 8 \times 8=64;$$
two equal factors taken
$$\sqrt[3]{64}=4, \text{ for } 4 \times 4 \times 4=64;$$
three equal factors taken

An index 2 means the square root, an index 3 means the cube root, an index 4 means the fourth root, an index 5 means the fifth root, and so on.

When the square root of a number is to be found the index is usually omitted, and the number is simply written under the root sign. Incidentally, the root sign is also known as *the radical*. Thus the square root of 64 would normally be written: $\sqrt{64}$.

While we are reviewing it would be advantageous to refresh our minds on the method of obtaining the square root of an arithmetical number. This will give us an opportunity, also, to talk in algebraic language, and further show the usage of some of the symbols we have defined. For our problem, find $\sqrt{796.417}$.

The first step is to segregate the number into groups of pairs, starting at the decimal point and working both ways. If the decimal portion of the number contains an odd number of digits, (a digit is any one of the ten figures, 1, 2, 3, 4, . . .), add a cipher at the right end to form a pair. Thus we get:

7 96. 41 70

The successive digits which we shall find to form the square root of 796.417 we shall call d_1, d_2, d_3, . . . In other words, d_1 will be the first digit in the root, d_2 the second digit in the root, and so on. The little subscripts 1, 2, 3 . . . written adjacent to the symbol d are merely for identification. Subscripts are often used for this purpose; they do not represent operations.

Appended hereto is a step-by-step solution of this problem. After one has gone through a few steps one becomes aware that the method of the steps is repetitious.

7 96.41 70 | 2
$2^2 = 4$

To find first digit in root, d_1

The first group is simply 7. Estimate d_1 so that $d_1{}^2$ will not exceed 7. Write d_1 in the root space, write $d_1{}^2$ under 7, as shown.

7 96.41 70 | 2
$2^2 = 4$
$2 \times 20 = 40$ | 3 96

Subtract 4 from 7, and bring down the next group. Multiply the number in the root by 20, and place the product to the left, as shown.

7 96.41 70 | 28
$2^2 = 4$
$2 \times 20 = 40$ | 3 96
$(40+8)8 =$ 3 84

To find second digit in the root, d_2

Estimate 396/40, to give a trial value of d_2. Hence try $d_2=8$. Place 8 in the root. Multiply (40+8) by 8, and place the product under 396. If this product had been >396, we had estimated d_2 too large.

7 96.41 70 | 28
$2^2 = 4$
$2 \times 20 = 40$ | 3 96
$(40+8)8 =$ 3 84
$28 \times 20 = 560$ | 12 41

Subtract 384 from 396, and bring down the next group. Multiply the number in the root formed by the sequence d_1 d_2 by 20, and place the product to the left as shown.

Since we have used up all the digits to the left of the decimal point in the number, we place a decimal point beside 8 in the root.

7 96.41 70 | 28.2
$2^2 = 4$
$2 \times 20 = 40$ | 3 96
$(40+8)8 =$ 3 84
$28 \times 20 = 560$ | 12 41
$(560+2)2 =$ 11 24

To find third digit in the root, d_3

Estimate 1241/560, to give a trial value of d_3. Hence try $d_3=2$. Place 2 in the root. Multiply (560+2) by 2, and place the product under 1241. If this product had been greater than 1241, we had estimated d_3 too large.

7 96.41 70 | 28.2
$2^2 = 4$
$2 \times 20 = 40$ | 3 96
$(40+8)8 =$ 3 84
$28 \times 20 = 560$ | 12 41
$(560+2)2 =$ 11 24
$282 \times 20 = 5640$ | 1 17 70

Subtract 1124 from 1241, and bring down the next group. Multiply the number in the root formed by the sequence of digits d_1 d_2 d_3 by 20, and place the product to the left as shown.

7 96.41 70 | 28.22
$2^2 = 4$
$2 \times 20 = 40$ | 3 96
$(40+8)8 =$ 3 84
$28 \times 20 = 560$ | 12 41
$(560+2)2 =$ 11 24
$282 \times 20 = 5640$ | 1 17 70
$(5640+2)2 =$ 1 12 84
| 4 86

To find fourth digit in the root, d_4

Estimate 11770/5640 to give a trial value of d_4. Hence try $d_4=2$. Place 2 in the root. Multiply (5640+2) by 2, and place the product under 11770. If this product had been >11770, we had estimated d_4 too large.

Hence $\sqrt{796.417}=28.22$ very closely. The root is not an exact root because the last subtraction left a remainder. Here, for example, is an exact root: Find $\sqrt{84.64}$.

$$
\begin{array}{rl|l}
 & 84.64 & 9.2 \\
9^2 = & 81 & \\
9\times 20 = 180 & 3\ 64 & \\
(180+2)2 = & 3\ 64 & \\
 & 0\ 00 &
\end{array}
$$

It is possible to obtain $\sqrt{796.417}$ more closely than 28.22 represents by finding the root to a greater number of decimal places. This is done by adding zeros to the right-hand end of the number—like this, 796.4170000000—and continuing the procedure for extracting the root until all the zeros are used up. Each pair of zeros appended to the number will enable us to find one more digit in the root, and the more digits found for the root, the more accurate the root will be. Just to show how this goes let's find two more digits in the square root of 796.417.

$$
\begin{array}{rl|l}
 & 7\ 96.41\ 70\ 00\ 00 & 28.2208 \\
2^2 = & 4 & \\
2\times 20 = 40 & 3\ 96 & \\
(40+8)8 = & 3\ 84 & \\
28\times 20 = 560 & 12\ 41 & \\
(560+2)2 = & 11\ 24 & \\
282\times 20 = 5640 & 1\ 17\ 70 & \\
(5640+2)2 = & 1\ 12\ 84 & \\
2822\times 20 = 56440 & 4\ 86\ 00 & \\
(56440+0)0 = & 0\ 00\ 00 & \\
28220\times 20 = 564400 & 4\ 86\ 00\ 00 & \\
(564400+8)8 = & 4\ 51\ 52\ 64 &
\end{array}
$$

Thus 28.2208 is a somewhat more accurate value for $\sqrt{796.417}$ than is 28.22.

It is easy to check the correctness of a root. For if one quantity equals another quantity, the square of the first quantity is equal to the square of the second quantity. In algebraic language:

$$
\begin{aligned}
\text{if}\quad b &= \sqrt{a} \\
\text{then}\quad b^2 &= (\sqrt{a}\,)^2 \\
&= a
\end{aligned}
$$

(To square a number under a radical, simply remove the radical.)

$$
\begin{aligned}
\therefore\ \text{if}\quad 9.2 &= \sqrt{84.64}\ \text{exactly} \\
\text{then}\quad (9.2)^2 &= 84.64\ \text{exactly}
\end{aligned}
$$

$$
\begin{aligned}
\therefore\ \text{if}\quad 28.2208 &= \sqrt{796.417}\ \text{closely} \\
\text{then}\quad (28.2208)^2 &= 796.417\ \text{closely}
\end{aligned}
$$

To make a check of this nature simply square the roots and note if the square equals or closely approximates the original number

$$
\begin{array}{r}
9.2 \\
\underline{9.2} \\
184 \\
\underline{828} \\
84.64
\end{array}
\qquad\qquad
\begin{array}{r}
28.2208 \\
\underline{28.2208} \\
2257664 \\
5641416 \\
564416 \\
2257664 \\
\underline{564416} \\
796.41355264
\end{array}
$$

(TO BE CONTINUED)

Many Important Changes in N. F. P. A. Projection Room Regulations

IMPORTANT changes in the Regulations for Nitrocellulose Motion Picture Film, particularly as applying to projection room practice, were adopted by the National Fire Protection Association at its annual meeting in Chicago, May 8 to 12. The changes were recommended by the Association's Committee on Hazardous Chemicals and Explosives, which group worked in close collaboration with the Projection Practice Committee of the S.M.P.E.

These changes are enumerated below, the new wording being indicated by italics:

191. Enclosures for Motion Picture Projectors. *For new construction, a size not less than 8 feet wide, 10 feet deep and 8 feet high is recommended for one projection machine, and not less than 14 feet wide, 10 feet deep and 8 feet high for two machines.*

(b) *The walls and ceiling of* the enclosure shall be built of brick, tile, or plaster blocks, plastered on both sides, or of concrete, or of a rigid metal frame, properly braced, and sheathed and roofed with sheet iron of not less than No. 20 U.S. gauge metal, or with ¼-inch hard asbestos board, securely riveted or bolted to the frame, or 2 inches of solid metal lath and cement or gypsum plaster. All joints shall be sufficiently tight to prevent the discharge of smoke. *Non-combustible acoustical material may be used on ceiling and wallls, on top of the plaster.*

For new construction, it is recommended that the walls of the enclosure be constructed in accordance with the requirements of subsection 112, paragraphs (1), (2), or (3), for partitions, with floor and ceiling of equivalent fire resistance. Modern heavy equipment may require special attention to floor strength and support. In some cases it may be necessary to support the projection room independently of the structure.

Projection Room Doors

(c) The entrance door into the enclosure shall be at least 2 feet by 5 feet, of construction equivalent to the sheathing permitted above for rigid frame construction, and shall be *self closing, swinging out,* and shall be kept closed at all times when not used for egress or ingress.

For new construction it is recommended that at least two doors be provided, each not less than 30 inches wide and 6 feet high. Doors should be approved fire doors of a type suitable for use in corridor and room partitions (Class C openings as defined in the Regulations on Protection of Openings in Walls and Partitions). Exists should be in accordance with requirements of authorities having jurisdiction, particularly

(*Continued on page* 27)

Boston Projectionist Writes His 2nd Fine Travel Book

THIS Arthur Foley of Boston projectionists' Local 182 has something, and that something is the ability to turn out a travel book which for style, insight, humor and inclusiveness puts to shame some of those who labor under the handicap of "professional writer". Every so often (or, to be specific, every year) Mr. Foley is victimized by a combination of claustraphobia (undoubtedly the result of a year's work as chief projectionist of the RKO Theatre in Boston) and a nostalgia for far-away places. And he does something about it—he just ups and goes.

Two years ago his book "Breezy Adventure," a racy and invigorating record of his travels in Europe and in the American maritime provinces, provided this writer with one of the most exhilirating travel volumes he ever read. Now Mr. Foley has done it again under the title of "Italian Ports of Call,"* which very aptly is subtitled "Mirth on the Mediterranean". It's a pip, even better than his previous effort.

Mr. Foley's latest book is a curious yet highly engaging mixture of sentiment, humor and practicality. From Boston to Gibraltar to Algiers to Naples to Malta, with many ports of call sandwiched in between, not a thing escapes the shrewd observance of the author. Life aboard ship, ashore at the various ports of call, the varied peoples, customs and noteworthy aspects of the many countries visited—all these are detailed in such a personalized manner as to make the reader want to pack his things and yell "Let's go!"

No counting of cobblestones or church spires, no straining after historical data for Mr. Foley. Not him. He goes where we upon our return from a trip wished we had gone. Avoiding the well-worn "tourist" paths that are so sharply etched out in every port in the world, Mr. Foley goes off on his own, pokes into this, that and the other corner, and comes up with the real low-down on the locality—he vitalizes the place and makes it come to life, so unerring is his vision and so sensitive his perceptions. And there is beauty in this volume, too—lots of it. Describing one port of call, Mr. Foley disdains to dish up the usual romanticism about the "glories of this ancient and hallowed city"; instead he relates his feelings as he and a charming young lady sail out of a moonlit-drenched harbor, the while they munch sandwiches and have a spot or two.

Mr. Foley brings to these 213 pages a freshness and directness of vision that is the basic essential of good narration. His senses are alive, his perceptions clear, and his conclusions objective in the extreme. He's done a swell job, one that we enjoyed tremendously. Bravo! Arthur.—J.J.F.

*ITALIAN PORTS OF CALL. By Arthur Foley. 213 pages. Bruce Humphries, Inc., 306 Stuart St., Boston. $2.

13 Winners in Final Diagram Contest

THIRTEEN winners were registered in the seventh diagram offered in I. P. last month. The circuit, that of a volume control amplifier, presented no unusual features, yet there were a surprising number of errors made by competent craftsmen who had previously worked out much more difficult diagrams. The errors in the diagram (Fig. 1) are as follows:

1. Dot added at the first crossing below R-1.
2. Dot added to the right lead to VT-1 filament.
3. Jumper added to the top of R-10 line running upward from C-7.
4. Jumper leading from No. 1 exciter lamp terminal No. 2 removed from "Common" and connected instead to "AC".
5. Jumper added, V.C.A. terminal A to V.C.A. No. 1 terminal C.

Those who doped out these circuit errors were: Henry E. Jeffery, Cortland, N. Y.; E. J. Doolittle, Baltimore, Md.; F. J. Pfeiff, Hamden, Conn.; J. J. Edgerly, Fall River, Mass.; Louis A. Briggs, Rochester, N. Y.; C. E. Mervine, Pottsville, Penna.; J. J. Carroll, Newburgh, N. Y.; George J. Beltz, McMechen, W. Va.; M. D. Faige, Springfield, Mass.; George Graffman, Philadelphia, Penna.; Jack LeRoy, Groton, N. Y.; M. Rushworth, Baltimore, Md.; and Anthony Discavage, Pottsville, Penna.

● **Contest Discontinued**

I. P. has decided to discontinue the Subscription Contest Diagram for the summer months, which decision was prompted by several factors. First, although there is ample evidence at hand to indicate that many readers work out the diagram without submitting their answers, a checkup discloses that practically the same group contribute replies each month. This in turn means that among the winners there are not a few who must already be surfeited with complimentary subscriptions.

Still another reason is the difficulty experienced in obtaining diagrams which, while applicable to the theatre sound picture field, are of such nature as to preclude the possibility of an original unaltered copy being available to some contestants and not to others, thus granting an unfair advantage to the very few.

Despite the most careful efforts on the part of I. P. to hide the identity of the various circuits presented, each month saw the receipt of not a few answers in which the diagram was readily identified. This could mean only that the contestant was familiar with the circuit, either through actual work thereon or by means of circulars distributed, and thus enjoyed an unfair competitive edge.

Undoubtedly there are many contestants who regard the Contest as admirable trouble-shooting practice and would desire that it be continued even if the free-subscription prize angle be eliminated. I. P. welcomes expressions of opinion on this point from such men, and if there be a sufficient number who vote for continuance of the Contest without the prize angle, I. P. will gladly oblige.

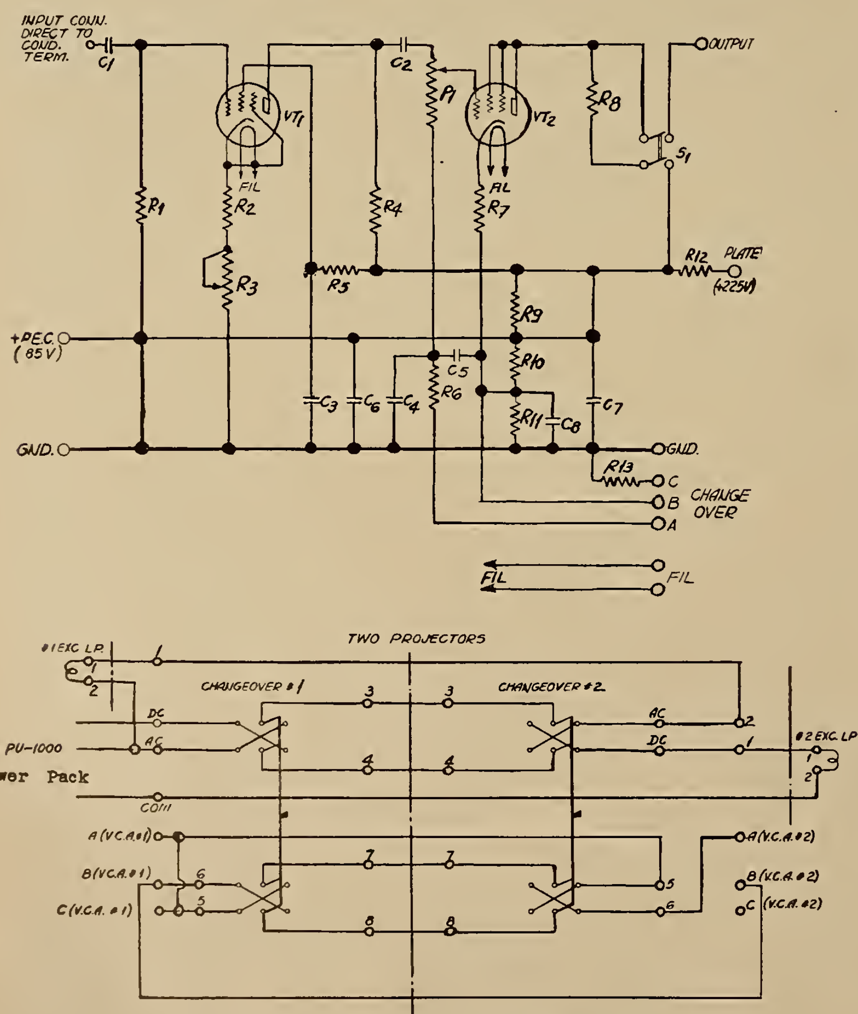


FIGURE 1. *Volume control amplifier*

Important N. Y. Decisions on L. U. Expulsions for Cause

Suit of two members, expelled for working an unfair job, against Newburgh, N. Y., Local 45, asking $5,000 damages each and reinstatement, was dismissed recently in N. Y. Supreme Court. Plaintiffs contended Local 45 had brought them to Newburgh from jobs in another town, that their expulsions violated Union by-laws, and that they suffered monetary loss because of their inability to follow their profession.

Trial testimony adduced the fact that the theatre had been picketed, and that the plaintiffs had been summoned before the Local executive board and informed that they invited expulsion by continued employment at the unfair theatre. Said the court:

Decision Upholding Expulsions

"They (the plaintiffs) knew of the situation, knew that the theatre had defied the Union, and by their continued employment were giving aid and comfort to the enemy of the Union . . . There is no question that the proprietor of the theatre refused to enter into any agreement with the Union, and that the plaintiffs, members of the Union, nevertheless persisted in working at the theatre, although they knew it had been declared unfair and knew that Union was opposed to their working there.

"It is quite apparent that at the time the plaintiffs felt independent of the Union, were satisfied with their positions, and had no intention of recognizing any obligation to the Union."

McGuire, Finn Named Honorary Members of British Guild

P. A. McGuire, of the International Projector Corp., and James J. Finn, editor of I. P., have been elected honorary members of the Guild of British Kinema Projectionists and Technicians, the representative projection craftsmen organization in England. Messrs. McGuire and Finn are the only American members of the Guild.

VALLEN vs AUTOMATIC DISMISSED

U. S. District Court at Philadelphia has dismissed the suit brought by E. J. Vallen and Vallen, Inc., against Automatic Devices Co. for alleged infringement of patents covering automatic curtain controls. Costs were assessed against the plaintiff.

Process Projection Specifications

A REPORT BY THE RESEARCH COUNCIL, ACADEMY OF M. P. ARTS & SCIENCES

THE appended report of the Process Projection Equipment Committee of the Academy of M. P. Arts & Sciences presents, for the first time, the coordinated viewpoint of the majority of the Hollywood studios on this subject and should prove a valuable addition to the industry's technical literature. Process projection methods continue to become increasingly important:

Economically, they offer opportunities for still greater savings in production costs.

Technically, developments in equipment and technique continue to expand the possibilities in this field until, some day, it will be the exception, rather than the rule, to send a cast on a distant location.

Artistically, as this equipment and technique is further developed the extent of its use will be limited only by the imagination of the production personnel; whereas, up to the present time, the equipment has been the limiting factor and only the ingenuity and resourcefulness of the technicians have made its wide use possible.

In a foreword to the report, Farciot Edouart, chairman of the Academy committee, states:

"Since the very inception of transparency process projection methods, it has been found in general that available projection equipment for this type of work is principally composed of an assembly of units never originally designed in their entirety nor engineered to be combined and worked together in such capacity. Basic elements of these assemblages were never intended to fulfill and meet such strict requirements as have been imposed upon such equipment by the consistent demand for higher quality rear projection results, and of the ever increasing scope required in the present stage of the motion picture art.

"*These recommendations are based upon Maximum Light Delivery with the following primary requisites: Absolute Steadiness of the projected picture with a Minimum of Light Variation on the screen, and Increased Efficiency of the Light.*

"The designer and manufacturer should regard any tolerances affecting these three principles as concessions to practicability, and any method of decreasing these concessions will be considered definite advancements in design."

The report, to be published herein in two instalments, is appended hereto:

PART I. THE BASE

CONSTRUCTION (Basic):

The base shall be so designed that it provides: (1) A rock-like stability during operation, when locked off, and facilities for panning and tilting with absolute smoothness and precision; and (2) sufficient portability so that the whole equipment may be easily moved about on its special carrier or dolly on the recording stage by not more than two men.

(Auxiliary): It has been suggested that this portability be accomplished by the use of a special carrier or dolly of the four-wheel type (on which the base will be mounted) equipped with solid rubber tires to insure safety and stability during movement of the equipment. The wheels should have the ability, free from any side-play or sway, to swivel and lock off in any direction for possible dolly shots. To increase stability, suitable jacks should be provided to lift the equipment off the wheels for stationary shots. Adequate bubble levels should be provided for leveling up the equipment.

PAN AND TILT MECHANISM (Basic):

In the design of the base, provision shall be made for a free-moving and easily operated tilt and pan mechanism, giving a smooth movement when in operation, but including a positive locking device, giving locked-off stability equal to the stability obtained were this pan and tilt mechanism not provided. There should be no backlash or play whatsoever in the pan and tilt mechanism, and means for adjustment should be provided to keep all working parts tight at all times. (See "Rotation of the Projector Head.")

(Accessory): The design of the base should also provide for the addition, when required, of a variable speed motor control of the pan and tilt mechanism, operating remotely from the camera position. The design of this remote control mechanism should provide for a gear ratio in the order of 900 to 1 between the drive motor speed and the speed of operation of the tilt and pan mechanism (to minimize over-control) as well as a gear box providing two lower gear ratios, making available all the necessary different speeds of operation.

MINIMUM DEGREE PAN AND TILT (Basic):

The base shall be designed to provide an angle of pan of at least 15° to both right and left of the center line between the projector and the screen, making a total minimum horizontal coverage of 30°, and to provide an angle of tilt of at least 10° above and below the horizon, making a total minimum vertical coverage of 20°.

INTERCHANGEABILITY (Basic):

The base shall be so designed as to allow for free, quick interchange of projection heads and lamphouses, registered with dowel pins or other positive means, so that a minimum of adjustment is required for lining up when a change in head or lamphouse is made.

(Accessory): *In the event that devices other than the regular base previously mentioned are provided to hold the projection head and lamphouse, the base on which the projection head and lamphouse rests should be designed so that projection heads and lamphouse are easily and quickly interchangeable to such devices.*

SOUND INSULATION (Basic):

The base shall include sound insulation to eliminate the transmission of noise. (It has been observed that sufficient sound insulation has been provided by insulating the setting jacks of the dolly with hard rubber. However, it must be remembered that any material so used must not in any way detract from the absolute steadiness of the whole equipment.) (See "Maximum Noise Level.")

HEIGHT OF OPTICAL AXIS (Basic):

The base and special carrier shall be so designed that the equipment's optical axis, when parallel to the stage floor, shall be 5′ 6″ from the stage floor.

PART II. THE LIGHT SOURCE

EFFICIENCY OF THE CARBON LIGHT SOURCE (Basic):

The type and size of carbon shall be

Classifications in Report

In order to clearly specify the relative importance of the various recommendations included in the report, each subheading in each part is indicated by one of the three following classifications:

BASIC—Recommendations so indicated incorporate definite requirements and principles. (Printed in bold face type.)

AUXILIARY—Recommendations so indicated are suggested methods of meeting basic requirements. (Printed in light face type.)

ACCESSORY—Indicates optional special refinements which add to the ease of operation of equipment. (Printed in italic type.)

carefully chosen for maximum efficiency in relation to the selected type of optical system and lamphouse.

(Auxiliary): It is recommended that all motion picture producing companies and commercial organizations using process projection equipment follow the manufacturers' rated burning conditions under which the maximum efficiency and minimum flutter and flicker are obtained from the carbon light source. (See "Light Control.") It is further recommended, to insure freedom from moisture or dampness, that carbons be kept for 48 hours before use in an electric heating oven operating at not to exceed 125° F.

TOLERANCES IN THE STRAIGHTNESS OF CARBONS (Basic):

Carbons for process projection shall be so selected by the manufacturer for straightness and concentricity of the core that when burned in a lamphouse developed and constructed to meet these recommendations, the equipment shall be able to fulfill the Tolerances under "The Feeding Mechanism," as well as the recommended "Tolerances in Light Variation of the Light Output."

MAGNETIC SHIELDING (Basic):

The current to the arc shall be so conducted into the lamphouse that no magnetic fields disturbing to the arc are set up.

INCANDESCENT LIGHT SOURCE (Basic):

It is recommended that further development work be conducted on incandescent and high-pressure mercury vapor lamps for general and special application to background process projection.

POWER SUPPLY (Auxiliary):

It has been suggested that a separate power supply be provided for the light source, inasmuch as a constant line voltage to the arc is imperative to accomplish the results to be obtained from equipment meeting these recommendations.

PART III. MAXIMUM VARIATION IN LIGHT OUTPUT OF EQUIPMENT TOLERANCES IN LIGHT VARIATION OF THE LIGHT OUTPUT (Basic):

The design of the whole equipment shall be such that the illumination from the carbon arc light source approaches as closely as possible the steadiness of an incandescent source. In any event, the amount of light variation during the projection of a scene shall be less than ±2% per minute, but with a maximum of ±5% for any consecutive nine-minute shooting period.

This tolerance is to apply only after a proper crater has been formed in the arc.

DEFINITION OF LIGHT VARIATION (Basic):

There are two distinct types of variation in the light output of an arc lamp, which can be designated as "flicker,"* viz: a *sudden sputter or brief increase or decrease in brightness*, and as "fluctuation"* viz, *moving in a slow wave of increasing or decreasing brightness.*

*NOTE: Flicker may be caused by the core of the positive carbon having different consistency in various spots, causing the arc to momentarily sputter, or by sudden air drafts or misdirected magnetic flux, or by misalignment of the negative carbon with respect to the crater.

Fluctuation is a mechanical or electrical problem and is caused by off-center rotation of the crater, the carbon feeding in an irregular manner, a crooked carbon, or disturbances in the line voltage.

FLICKER—METHOD OF MEASUREMENT (Basic):

Flickers are generally too fast to be measured by any presently known meters, but shall be measured by photographing a clear screen illuminated by the arc lamp source. Each frame of the exposed, developed negative, over given portions, can then be read on a densitometer.*

FLUCTUATION—METHOD OF MEASUREMENT (Basic):

Fluctuation can be easily read and recorded with an accurate, sensitive light-recording photometer.

*NOTE: It is recognized that this method of measuring flicker may not be the most accurate, due to variations in film development, but is one simple means available at present. The Committee will welcome suggestions on more accurate methods which may be devised.

PART IV. THE LAMPHOUSE

General Recommendations Applying To Both Mirror and Condenser Type Lamphouses

CAPACITY AND OPTICAL SPEED (Basic):

Recommendations covering capacity and optical speed for each type of lamphouse are given in that Section of this Part of the Report specifically applying to each type of lamphouse.

NOISE LEVEL (Basic):

The noise level of the lamphouse in operation shall be 3 db below the noise level specification given for the whole equipment in that part ("Noise Level") of these recommendations. This specification must be met without the use of booth or blimp on the lamphouse.

(Auxiliary): It has been suggested that acoustic treatment of the lamphouse might prove effective in meeting the above basic noise level recommendations.

(Continued on page 24)

Panic, the Butcher

This is a condensation of an article which originally appeared in *Columbia*, official organ of the Knights of Columbus, by whom it is copyright. It bears directly upon the problem of safety in the theatre, with which projectionists are so intimately concerned

IT WAS the afternoon before Christmas, and in a small social hall in Calumet, Michigan, a woman's club was holding a party. The building was a two-story brick structure with the meeting place on the second floor, reached by a single six-foot-wide stairway. After a while the lack of ventilation, the crowd, and the steam heat began to make the room stuffy, and one of the women fainted. Somebody near her called for water. Somebody else, not so near, noticed the confusion, and, for some inexplicable reason, screamed "FIRE." And the consequence of that bit of thoughtlessness was the slaughter of 73 of the women in that little hall only ten feet above the street!

The firemen arrived a minute or so after an outsider turned in an alarm. By that time the bodies on the stairway were piled so high that the men had to throw ladders up to the window to get in. And when they raced to the head of the stairs, they found two elderly women in a frenzy of hysteria, jumping up and down madly on the stack of dead and dying!

● **Fail to Note Exits**

Similar things have happened many times and, in all probability, will happen again. In Baltimore 40 people died in a theatre crush over a false alarm fire; in Ville Platte, Louisiana, 27 were killed in a panic caused by a trickle of smoke; and in a Montreal movie house 78 children were trampled to death. The last was a real fire—but in the most notorious panic of modern times, the Iroquois Theatre disaster of Chicago, 572 persons lost their lives in a blaze which did only nominal damage to the building itself.

Thus can panic produce butchery even without the aid of fire. The reason why sane people become maniacs in a crisis is that they never stop to think what they might do should an emergency arise. How many really "look for the nearest exit" before they settle themselves for the show? How many on going to a hotel for the night ever think about the business of getting out in a hurry? Very few. The upshot is exactly the same in every public fire we have: all the occupants attempt to go out the same way at the same time—*they go out the same way they came in*, which is the only way they know—and that pathway promptly becomes congested. One impatient shove, one excited scream, and a taut crowd becomes a savage pack of animals.

The first sensible rule is never to go into a theatre or public building without due thought to the matter of exit. Notice especially, a second path of escape—the nearest side aisle in the theatre. the stairway at the other end of the hall in the hotel, *etc.* Fix it firmly in your mind If an emergency arises, use that path of egress for yourself and your family because you can be positive that nine-tenths of the others in the building will try to utilize the main entrance.

A few years ago ten girls were killed in a movie studio fire in New York primarily because they failed to look for a second exit before it was needed. Their

dressing rooms were on the second floor, within easy reach of two supplementary paths of exit. But those girls had always come up by the main stairs, and they went out that way when they had to make a quick escape. The stairway was a roaring oven when they attempted it.

Wide-awake cities commonly provide that in a theatre "no seat shall be more than seven seats from an aisle." And when theatre managers know their business they see to it that ushers lead as many possible to their seats by side aisles instead of down the main one. Perhaps you have wondered at times why the usher made you crawl over the knees of five others when it would have been easier to have gone down the main aisle: they are trying to divert a maximum of traffic away from that aisle against the ever-present contingency of emergency egress. Common sense behavior in a public place is to expect the worst and formulate some tangible plan of action before it happens. The result is that you automatically do the right thing because the danger is not unexpected:

But, to be sure, not all of the ghastly record of panics can be charged to the behavior of the victims. If there *aren't* any supplementary exits, if doors won't open, if stairs are unprotected or too steep or have sharp turns, you can't expect undisciplined people to do anything but lose their heads. The second antidote for panic, then, is to be found in common sense fire regulations. Though many building owners object to the provisions of fire codes, they object because they have no conception of the problem involved. While the owner racks his brain for ways to "get them in," someone else has to worry about the more vital problem of *getting them out.*

This failure of owners to appreciate the risks of panic leads to many atrocious violations of existing codes—or to the total neglect of safety principles where no codes exist. Thousands of cases comparable to the following come to light every year.

● Movie House Deficiencies

A few months ago an inspector found a brand-new movie theatre in a New England city equipped to seat 5000 patrons. When he asked to see the supplementary exits, they pointed to a red-lighted door up near the stage and when he opened that door he discovered that it led to a ten-foot drop to the river below! Another exit on the side was examined. That was seven feet above the street—and there were no steps. Despite these conditions, a check-up showed that they were packing 7500 patrons in a place designed to hold 5,000!

In another theatre the owner was compelled to add a secondary exit when it was discovered that none had been provided in the original plans. This was done willingly enough when the need was explained—but where do you suppose they built it? At the side of the building furthest from the street, leading into a four-and-one-half foot light shaft entirely surrounded by the adjoining building. From this trap, which would hold about 20 persons, *there was no escape for any* of the 2,000 patrons who might use it!

● Closer Inspection Urged

The only solution for such stupidities —which are by no means rare—lies in relentless activity on the part of the local fire department, intelligent ordinances, and rigid inspections backed up by aggressive public opinion. For if the people themselves aren't concerned with their own safety, no one else will be.

All these warnings apply to non-professional social assemblages, which invariably present a far greater hazard than the worst public places. The fraternal or club gathering, the amateur play, the crowded meeting in church hall or school—these affairs are of temporary duration and are managed by folks who have no knowledge of the fire problem and little legal obligation. The curse of all these gatherings is the common use of chairs that are not fastened to the floor or at least made into rigid units of five or six seats. At the first sign of trouble, chairs are tipped over, aisles blocked, and excited people begin to fall right and left.

Another danger is the lack of checking facilities for coats and wraps which are carried into the meeting place and draped on chairs whence, at the earliest outbreak of confusion, they fall to the floor to be tripped over. It should be an ironclad rule to have ample check rooms. Beyond these elementary risks there are dozens of others. Aisle space is reduced to an absolute minimum and no regard whatever is paid to the importance of keeping exits and fire escapes unobstructed.

Weber Announces Syncro-Magnetic Soundhead

Weber Machine Corp., of Rochester, N. Y., pioneer independent sound equipment manufacturer and contributor of many notable advances to the art, has announced a new Syncro-Magnetic soundhead which employs a patented magnetic filter having approximately 40 pounds of "flywheel" balance. All of the starting load and shock has been eliminated, according to Weber engineers, and the new head starts more gently and maintains as perfectly a uniform motion as is humanly possible to obtain.

In thus solving the problem of constant speed, Weber claims not to have sacrificed a single detail that makes for improved performance, trouble-free operation and convenience.

● Advanced Optical System

The optical system of this new head is of the very latest improved design, running up to 10,000 cycles, and is easily and quickly focused. Lateral adjustment of the film is provided for to accommodate any variation of the sound track from standard. The secondary optical system is easily adjustable, and it can be speedily replaced with one for push-pull or any other advanced type of recording. Pre-focused exciter lamps mounted on a turret can be put into service by merely flipping a lever.

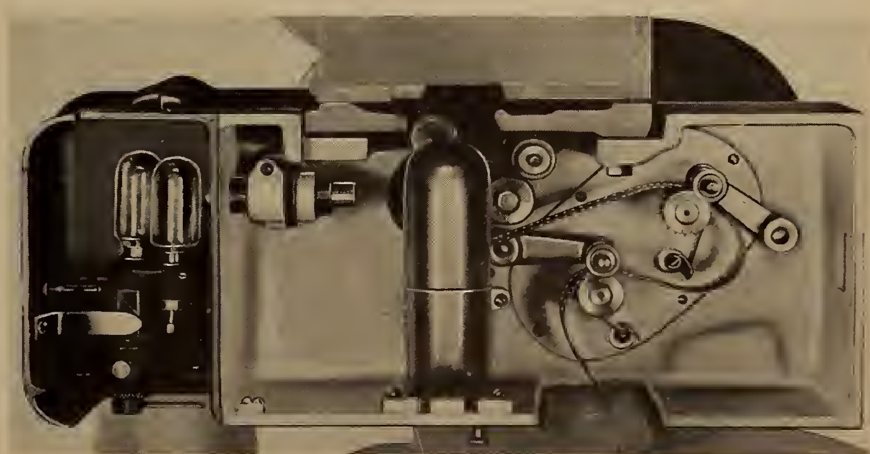
Film is easily threaded into the soundhead. All sprocket roller levers are rugged and self-locking. Ample room and accessibility are provided for the projectionist, and the pilot light has a separate switch. All bearings are high-grade ball bearings, and no oil is necessary at any time.

Further details of this new Syncro-Magnetic soundhead are available from the manufacturer at 59 Rutter St., Rochester, N. Y.

FRANK HEADS N. Y. N. T. S.

James Frank, Jr., has been named Manager of the N. Y. City branch of National Theatre Supply Co., succeeding C. H. Secor, resigned. Previously Frank was assistant sales manager of International Projector Corp. and with the sales promotion section of N. T. S.; before that he was for eight years with RCA.

Frank is Secretary of the S. M. P. E. and is well known for his articles on sound engineering, notably those appearing in I. P. under the name of Frank T. Jamey, Jr.



Weber's new Syncro-Magnetic soundhead

Film Preservative Tests

AN ABSTRACT OF A REPORT BY RELEASE PRINT QUALITY COMMITTEE
RESEARCH COUNCIL, ACADEMY OF M. P. ARTS & SCIENCES

TREATMENT given to release print film after it has been printed, developed and dried is commonly called "film preserving," and the processes by which this treatment is given are known as "film preservative" processes.

The gelatin of freshly developed film carries a high percentage of moisture in its pores, and as long as this condition prevails is known as a "green" emulsion. A so-called "green" emulsion is quite soft and the slightest abrasion will cause a scratch. These scratches widen out as the gelatin dries, and cause the "rainy" effects seen on the screen in the theatre.

As film with "green" or soft emulsion passes through a projector, it leaves small deposits of emulsion on the tension shoes at either the aperture plate or the sound gate, unless the tension shoes are kept thoroughly lubricated. Such deposits build up resistance to a free passage of the film over them, and scratch the film during projection.

When the moisture in a "green" emulsion is withdrawn too quickly, the gelatin shrinks and the film warps or buckles. If too great an amount of moisture is withdrawn from the gelatin, the film becomes brittle, loses its pliability and is easily torn while being projected.

Any treatment offering a preventative of the above conditions must be applied to the film after it has been printed, developed and dried. A film preservative treatment for release prints should:

(1) Prevent scratches in new or green emulsion.

(2) Thoroughly lubricate the emulsion so that it will not adhere to any part of the projector.

(3) Impregnate the gelatin with a fixed chemical which will not be dissipated by the intense heat of the projection lamp, but will take the place of the moisture that is withdrawn to thus prevent warping and buckling.

(4) Retain the film's pliability indefinitely.

The Test Procedure

It was decided that a comparative test of the commercially available preservatives could best be made by including in one reel a sample of release print treated by each of these processes, and subsequently subjecting this test reel to release print film projection under actual theatre conditions.

A 2000-foot reel of film was secured from a regular release, cut into 200-foot samples and each sample subsequently treated by one of the following preservative processes:

- Consolidated edge waxing.
- Eastman cold waxing.
- Gage process.
- Metro-Goldwyn-Mayer edge waxing.
- Paramount process.
- Peerless process.
- Perfexit process.

The reel also included one 200-foot sample of unprocessed release print*.

This test reel was then subjected to approximately ten months actual theatre use. The reel was projected in all types of theatres,—first, second, third run city theatres, and subsequent run neighborhood houses, so selected that the reel would be projected in theatres equipped with all types and makes of projection equipment.

This film was mounted on a standard commercial 2000-foot reel and was transported from theatre to theatre in a regulation I.C.C. shipping case by various available commercial transportation facilities. It was received and handled by the theatre projectionist in exactly the same manner as an ordinary release print and was projected in each theatre from two to six times (depending upon the time available in each particular theatre for this test), upon each of the projectors installed in each theatre.

In other words, the reel was subjected as closely as possible to the conditions to which an ordinary exchange release print is subjected.

*It should be noted that the above listing of processes tested is alphabetical and bears no relation to the order of listing in Table A.

Under these conditions, the reel was projected a total of 439 times. The film was then examined (1) being inspected by projection (2) cleaned and reprojected (3) inspected by hand (4) measured for shrinkage and (5) tested for surface hardness.

The Analysis Procedure

This analysis indicated the following conclusions: The first inspection by projection showed the film to be filled with dirt, scratches and oil, and each of the samples appeared to be in very poor condition. The first and last samples on the reel were in the worst condition, as would be expected, due to the handling of the film in threading and rewinding.

After the Test Reel had been cleaned several times and reprojected, the conclusions from the first observation were revised because of the fact that the true condition of the film was obscured by dirt and oil. The film was in much better condition than was first indicated. The amount of oil on the film was more objectionable than the scratches remaining on the film after cleaning.

The tabulation in Table A shows the results of the various observations in a fairly concise form. Shrinkage measurements were made with the Paramount Film Gauge. This gauge is accurate to within .001" in 3', and has been calibrated against both the Eastman and Dupont gauges.

The hardness test was made by drawing the film between a flat surface and a steel point with adjustable weights, set to provide various pressures. A certain pressure is applied on the steel point and increased until the steel point starts abraiding the film. The good samples, with 3 pounds of weight on the steel

TABLE A. ***Results of various observations on test reel***

Process	Projection Before Cleaning	Projection After Cleaning	Hand Inspection	Hardness Center	Hardness Edge	Shrinkage in 1 Foot
Sample No. 1	Dirty and pitted, particularly at beginning.	Fairly free of abrasions, except beginning.	Beginning badly pitted and short scratches.	Fair.	Good.	.062"
Sample No. 2	Fairly clean.	Fairly free of any noticeable abrasions.	Less scratches than No. 1.	Poor.	Good.	.065"
Sample No. 3	Fairly clean.	Fairly free of any noticeable abrasions.	Long scratches in center of film.	Poor.	Good.	066"
Sample No. 4	Dirty and pitted.	Fairly free of any noticeable abrasions.	Long scratches in center of film.	Poor.	Good.	.067"
Sample No. 5	Dirty and pitted.	A few long scratches in center.	Better than No. 3 and No. 4, but some short scratches.	Good.	Good.	.065"
Sample No. 6	Fairly clean.	Fairly free of abrasions.	Some long scratches	Fair.	Good.	.066"
Sample No. 7 (Unpreserved)	Dirty and pitted.	Long, heavy scratches.	Long scratches heaviest on this sample.	Poor.	Good.	.065"
Sample No. 8	Beginning good, end full of short abrasions.		Beginning quite free of abrasions.	Fair.	Good.	.057"

point, slid easily through without any emulsion abrasion; whereas the poor samples received deep gouges.

The hand inspection showed that all the samples have perforation nicks throughout, due to pulling in the projectors. Some of the samples appeared to have less lengthwise scratches than others, which seemed to be the main difference between the various samples.

● Summary of Findings

After inspection of the samples it would be rather difficult to point out any one sample as outstandingly better than the others. Samples 2, 3, 4, 5, and 6 appear to be in the best condition, then 7. Samples 1 and 8 are about as good as the first group, except for the beginning of 1 and the end of 8, which sections are by far the worst of any of the samples.

It is interesting to note that the edge of all the samples show equally well in the hardness test, the main variation being in the center of the frame. The greatest benefit from any of the preservatives is probably at that period when the film is green, as a preservative will permit projection without chatter in the projector gate. However, after the samples become old, the natural hardening of the emulsion and glazing by the projection shoes tends to equalize the differences along the edges of the film.

The last sample was not on the reel the same length of time as the rest of the samples, having been added some weeks after the Test Reel was originally made up. For this reason, the shrinkage figures are, and should be, somewhat smaller than those found in the other samples.

The sound track area of the various samples did not seem to suffer any more than the picture, but the background noise was probably higher than when the film was new. For the information of those interested, the following is a sample formula for an edge waxing solution:

50 oz. Trichlorethylene
50 oz. Benzol
7 oz. Parowax
2½ oz. Pyroil "B" Grade

● Committee Recommendations

These tests indicate that because of the fact that a film preservative contributes to better projection as well as longer life, all release prints should be given some treatment before being placed in use. It is further recommended that in order to obtain full benefit from a preservative, any preservative used should be applied at the laboratory during the release printing procedure.

However, the results of this one test indicate that all of the preservatives tested benefit the film, and in the opinion of this Committee there is little difference between the results obtained from any one or the other of the various preservatives which were under consideration.

Due to the fact that new film preservative processes will be developed from time to time and changes in existing processes will likely be made, we recommend that additional tests similar to this be made as necessary, and if so desired this Committee will be glad to conduct such tests.

In conclusion, the Committee wishes to acknowledge with thanks the helpful cooperation of Ferdinand Eich of the Paramount Studio Laboratory, who conducted much of the investigation outlined in the foregoing report, and of the managers and projectionists of the many theatres who cooperated in the tests upon which this report is based.

New Erpi Mirrophonic 'Master' Theatre Sound System

EMPHASIZING the trend that has featured many recent sound equipments, Electrical Research Products' new Mirrophonic Master system, exhibited recently, was designed and built around the two principles of maximum simplicity and accessibility.

New developments of special interest to projectionists center largely about the soundhead, the film side of which is shown in Fig. 1. It will be noted that the exciter lamp and the photocell are now at the same side of the head, the lamp on top and the cell beneath. The basic optical arrangements are plainly shown in the illustration.

● Utilizes Single Sprocket

The drum on which the film rides as it passes the exciting light is that of the kinetic scanner, modifications of which are confined to the drive side of the head, and discussed subsequently.

The most unusual feature of the operating side is the use of a single sprocket to provide that protection against flutter usually afforded by two sprockets. This sprocket is oversize; it will be noted that the film is threaded against the upper circumference and held in place by idler rollers; then follows a short loop and the film is returned to the lower circumference, and another set of idler rollers. The length of film and the number of sprocket holes engaged are about the same as though two sprockets of ordinary size were used, but the gear train is, of course, simplified, thus enabling greater economy and reduced chances of trouble.

The rotating elements of the kinetic scanner are hermetically sealed in the Master system, and utilize a new liquid. The principle of action is unaltered; the drum seen in Fig. 1 is an extension of the outer rotary unit, which contains within itself a flywheel from which it is separated only by a film of liquid .0001 inch thick. When the motion of the film sets the drum rotating, the motion is imparted to the inner flywheel through the liquid contact on a principle somewhat similar to that of a friction clutch, and the flywheel, once it is moving, steadies the rotation of the drum.

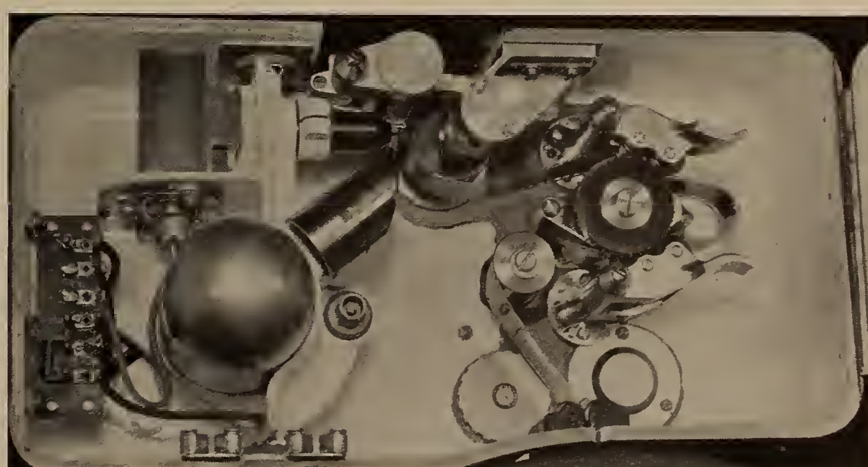
● Driving Arrangement

Stability of operation at all temperatures, however, requires that the coupling liquid shall not change greatly in viscosity when warmed or chilled. In the new scanner, the fluid used is one specially developed for the purpose by Bell Telephone Laboratories and said to cost $200 per gallon. Hermetic sealing of the unit insures that the trifling quantity originally built-in will never have to be replaced. Its stability in suppressing flutter at all temperatures is reported as ten times greater than that of any liquid previously used for the purpose.

Other soundhead features include the

(Continued on following page)

FIGURE 1



mounting of the motor at the side, which leaves the armature in horizontal position at all projection angles. Lubrication leakage is reduced, and the motor requires no thrust bearings.

Drive linkage to the projector is by a silent chain; the head in consequence is more easily aligned. An improved mounting plate further facilitates alignment. Projector heads can be changed between reels and still be perfectly mounted.

Soundhead wiring terminals are shown at the extreme left of Fig. 1. The ground terminal is at the top; the next pair, reading down, are Exciter— and Exciter+; the next stud is the 90-volt+, and the bottom pair, bridged by a resistor, carry speech output to the coaxial cable.

Speech from both projectors is run to a three-stage pre-amplifier (Fig. 2), with exciter lamp resistors at the bottom of the cabinet. The right side of the cabinet carries, at the top, the changeover switch, and beneath that, the volume control. Contacts of both switch and control are of the commutator type, the "brushes" being phosphor-bronze spring contacts.

The amplifier chassis at the middle of the cabinet of Fig. 2 resembles a radio chassis that has been turned on its side to make all the wiring accessible. Every contact and connection can be reached with the amplifier in this normal operating position. Resistors are not marked with numerical ratings, but, as may be noted in the illustration, are color-coded. Tubes are Western Electric.

Speech from the pre-amplifier is wired to the system amplifier, which has a meter panel that is readily removable by the loosening of two screws: it can be set at the bottom of the cabinet with its cable form still connected for continued meter operation during the course of servicing. When this is done, the appearance of the amplifier resembles that of Fig. 2—a radio chassis set on end with every connection exposed.

Terminal strips for external wiring are visible along the bottom of its chassis; a

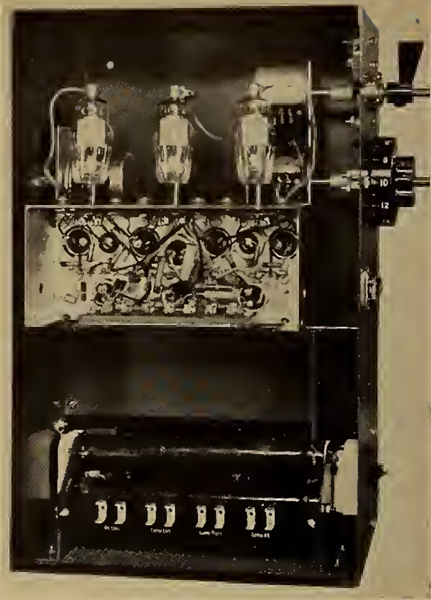


FIGURE 2

line of resistors at its top, left, are for modification of frequency response.

● **Amplifier Rating, Hook-up**

The amplifier is resistance-coupled throughout, with phase inversion to the push-pull stage. Output is rated at 15 watts with 2% distortion. Its meter is calibrated in terms of percentage. The switch for reading different circuits is on the meter panel, the monitor volume control at its right. A separate, single stage is included for monitor sound supply, eliminating variation in screen speaker volume when the monitor control is adjusted. The design contemplates use of two of these amplifiers in parallel, when necessary, and the addition of a Mirrophonic 87-type amplifier (I. P. for Dec., 1936) for still greater volume.

The system includes a tube rectifier power unit, an interesting special feature of which is the use of a voltage regulator tube to stabilize the exciter lamp supply. It is simply a lamp with a long filament, the resistance of which increases, of course, with temperature rise. This filament is in series with the output line; increased current through it, raising its temperature, results in increased filament resistance, and vice versa. These compensating changes in the filament voltage drop stabilize the voltage at the output terminals against fluctuations of line current or of rectifier action.

Loudspeakers of the Master system are of the Mirrophonic type previously used.

Erpi will first market this new equipment abroad. An announcement covering merchandising arrangements in the United States is expected in the very near future.

New DeVry 16 mm. Projector For Theatre Use

A new 16 mm. projector which utilizes a high-intensity carbon arc lamp was introduced recently by the DeVry Corp. and created unusual interest among projection men. The unit, intended for projecting local newsreels in regular motion picture theatres, incorporates all of the essential 35 mm. mechanical requirements necessary for heavy-duty use, including a sprocket intermittent instead of the ordinary amateur claw-type system commonly found in 16 mm. projectors.

A unique system of forced draft ventilation has enabled continuous test runs of 50 hours without overheating the unit. The projector has a capacity of 4000 feet of 16 mm. film, sufficient for a run of 1¾ hours. Complete details available from the company at 1111 Armitage Ave., Chicago.

New Projectors by Brenkert, Wenzel; Forest Lamp; Brenkert-RCA Sales Tieup Highlight Radical Supply Field Changes

RECENT radical changes in the manufacture and merchandising of projection room equipment merit the attention of projectionists. Most interesting development in the manufacturing field is the introduction of a new 35 mm. professional theatre projector by the Brenkert Light Projection Co., of Detroit, well-known in the field as the makers of Brenkert arc lamps, effect machines and, until recently, rectifiers.

No detailed information anent the Brenkert projector is available to date, although it is known that many units are ready. Brenkert states that they have been tooling up for this job for the past two years.

Of extreme interest is the merchandising plan which becomes effective with the introduction of this new projector. Brenkert announces that the head will be handled by Brenkert dealers throughout the country; and that a deal has been worked out with RCA Photophone whereby the latter will cooperate with Brenkert dealers in all sales and servicing efforts. Thus, a given dealer will be able to equip a projection room complete: the dealer will have the right to offer RCA sound units, and RCA will have the right to offer visual projection equipment. Ample financing on sales is reported set.

Currently many dealers are handling both Brenkert lamps and Motiograph projectors, thus there will be inevitably some radical switches in policy pending the final dealer alignment. Moreover, it is expected that Altec Service Corp. will stand idly by in the face of the wide competitive advantage enjoyed by RCA in the service field through its tie-up with Brenkert.

Also closely tied-in with the Brenkert distribution setup is the Benwood-Linze Co. (formerly B-L Electric Co.), of St. Louis, which has taken over the Brenkert rectifier, made certain changes therein, and will market through Brenkert dealers, and the Robin Steadypower generator. The addition of a screen manufacturer to this group would not be surprising.

● **Wenzel Head; Forest Lamp**

Another professional theatre projector will shortly be made available by the Wenzel Co., of Chicago. It is understood that a development by two Detroit projectionists forms the basis for this new Wenzel job, details of which are

N. Y. World's Fair Visitors

Readers of I. P. who contemplate visiting the New York World's Fair are cordially invited to avail themselves of the facilities of the I. P. office in the matter of hotel accommodations, reservations for amusements or for any chore which will help to make their visits more enjoyable. Ample advance notice is preferable.

expected to be forthcoming shortly.

A new Suprex lamp to be ready within thirty days is announced by Forest Mfg. Corp., of Belleville, N. J., which already sponsors the Forest magnesium copper-sulphide rectifier and the Hurley sound screen. No data anent this new lamp have been released as yet, although Forest asserts that it will uncover a radically new means for arc feed control.

I. A. Revokes L. 37 Charter, Forms Five New Locals

The charter of Local 37, largest I. A. unit with more than 6000 members, has been revoked by the General Office, and in its stead five new locals have been formed to accommodate the various classifications of workers. This drastic move climaxed the almost uninterrupted warfare—including numerous court battles, physical violence at meetings, appeals to the Federal government by both sides and general confusion—which has marked relations between the International and its West Coast studio workers.

Dissolution of Local 37 was ordered on the eve of superior court hearings on suits filed by the International and Local 37 against each other for control over the Local.

The International avers that its actions are directed at ridding its studio affiliate of Communistic and other subversive elements; while Local 37, through officials ousted by the I. A., sets as its goal the restoration of local autonomy.

New units chartered by the I. A. to supplant Local 37 are: Local 80, all grips and special effect men; 44, laborers and utility workers; 727, studio projectionists; 165, all handlers of electrical apparatus, and 728, recording men.

Ed Cahill Heads Photophone Div. of RCA; Keeps Service

Ed Cahill, director of service operations for RCA Mfg. Co., has been assigned additional duties as general manager of the entire Photophone division of that company. Harry Sommerer, former manager of Photophone, has been named assistant to the executive vice-president. Homer Snook will continue to direct Photophone sales.

Cahill is well known to hundreds of projectionists throughout the country as a result of his activities in the servicing field. Before going to Camden he handled RCA service in the Chicago area.

KILL N. Y. MANPOWER BILL

Bill making compulsory the employment of a projectionist for each projector used in theatres in N. Y. City met with a stunning defeat in Assembly recently, being licked by a 81 to 33 vote. I. A. legislative representatives openly predicted victory by a close margin.

SLIGHT INDUSTRY UPSWING SEEN BY POOR'S SURVEYS

Moderately improved operations will be experienced by the motion picture industry during the second quarter of 1939, although

theatre attendance and box office receipts are expected to hold at levels only slightly in excess of last year, according to Poor's Surveys.

Contrasting with this fairly satisfactory outlook, a combination of political factors are disturbing, the survey continues. In addition to the Department of Justice's anti-trust action are (1) the Neely "block-booking" bill, now before the Senate Interstate Commerce Committee, and (2) threats of National Labor Relations Board hearings on wages, strikes, and union activities. At this juncture, it is difficult to forecast the ultimate outcome of current and pending litigation.

As for "block-booking," arguments pro and con seem to be pretty well in balance. Whether its elimination ultimately would prove beneficial to the industry is anybody's guess. Increased competition and higher production costs would be a natural consequence.

Theatre Construction Off

With prospects indicating no important increases in theatre attendance, the incentive for building new film outlets has been dampened in recent months. Extending the decline experienced during 1938, contract awards during the first two 1939 months were nearly 45% under those of a year earlier, with February, 1939, registering a 51% slump. Some improvement may be witnessed later this year, however, if the industry's prediction of another upswing in box-office receipts materializes.

Reflecting the unsettled European situation and recent years' rise in quota systems and other restrictive measures, exports of domestic films in January, 1939, were nearly 15% under year-earlier volume, thus extending the 10% decline under 1937 shown in 1938.

DEVRY VISUAL CONFERENCE

The ninth annual National Conference of Visual Education, held under the auspices of the DeVry Foundation, will be held at the Francis W. Parker School, Chicago, June 19-22. The sessions will feature almost continuous showing of selected industrial and educational film, in addition to addresses bearing on equipment and technique.

8TH DISTRICT MEET JUNE 4

Convention of all I. A. locals in the 8th District will be held June 4-5 at the Portage Hotel in Akron, Ohio. More than 100 local delegates, plus international officers, are expected to attend.

DETROIT L. 199 ELECTION

Roy Ruben was elected financial secretary of Local 199, Detroit, succeeding M. A. Hawkes, deceased; D. F. Erskine was re-elected v.-p.; Joseph Sullivan, rec. secretary, and H. S. Morton a trustee.

GUERCIO-BARTHEL MOVE

Guercio & Barthel, theatre engineering and supply house in Chicago, will move early in June to their new building at 1241 South Wabash Ave.

A. A. COOK JOINS WOLLENSAK

Alan A. Cook, well known in the theatre field as a result of his work in projection optics for Bausch & Lomb Co., has joined the scientific staff of the Wollensak Optical Co., Rochester, N. Y. He will specialize as a consultant and optical designer.

PROCESS PROJECTION

(*Continued from page* 18)

STRIKER MEANS (Basic):

The lamphouse shall be provided with a striker, hand or motor, which produces no detrimental magnetic effects on the burning of the arc and which will not shatter the crater.

VIEWING PORTS (Basic):

Large adequate viewing ports shall be provided in both sides of the lamphouse, located at the most advantageous position.

LAMPHOUSE DOORS (Basic):

The lamphouse door shall open upward rather than outward (forward or backward) and shall be provided with a positive holding device when open. (It has been suggested that the lamphouse doors be of the type which fold or collapse into a smaller unit when opened.)

CONTROL AND METER PANEL (Basic):

Controls and meters shall be centrally located at one position on the operating side (the right side facing the screen) for ease of operation of the

equipment (except for special purposes.)

OPERATING POSITION (Accessory):

The lamphouse should be adaptable to operation from either the right or the left side for special purposes.

LINING UP METHOD (Basic):

A small port shall be included in the rear housing of the lamphouse in line with the optical center of the equipment so that, with no carbon in the mechanism, preliminary lining up may be accomplished by sighting through the carbon jaws and aperture.

INTERCHANGEABILITY OF BURNER ELEMENTS (Basic):

The burner elements, both the positive and negative, shall be easily removable from the lamphouse in order to replace parts and to facilitate cleaning, and shall be interchangeable between lamphouses of the same type.

ASH TRAYS (Accessory):

Removable trays in the bottom of the lamphouse should be provided to catch debris and to facilitate keeping the lamphouse clean.

VENTILATION FOR MAXIMUM DEGREE TILT (Basic):

The design of the ventilating system shall be such that the ventilation will not be reduced when using the lamp at a maximum angle of tilt of 30° above or below the horizon.*

HEAT INSULATION (Basic):

The walls of both type lamphouses shall be so designed and treated that the heat will be conducted through the chimney rather than radiated out through the side of the lamp, thus lowering the temperature of the lamphouse.

(Auxiliary): It has been suggested that should the lamphouse not be used with a portable equipment, a metal cover be provided over the upper part of the lamphouse with sufficient clearance to set up a draft between this cover and the lamphouse, to carry the heat transmitted through the lamphouse up the chimney.

MATERIALS OF CONSTRUCTION (Basic):

All parts of the lamphouse and shield (baffles) shall be constructed to distribute the magnetic flux in a manner that will not disturb the proper burning of the arc.

VISUAL INDICATOR DEVICES (Basic):

An indicator shall be provided comprising a compact, rigid optical system having a visual target index to show the burning relation between the carbons. An indicator shall also be provided to show the length of trim left in the lamp.

METERING FACILITIES (Basic):

An accurately calibrated and depend-

*NOTE: In the opinion of the Committee, a 30° angle is the maximum tilt at which it will be necessary to burn the lamp. This angle is greater than the minimum degree of tilt specified previously for the projector, but may at times be reached in operation due to the equipment as a whole being purposely set off-level in some particular setup.

able ammeter and voltmeter shall be provided in the electrical circuit to show the arc current and voltage.

Recommendations Applying Only to the Mirror Type Lamphouse

CAPACITY (Basic):

The lamphouse shall be designed to be convertible to accept either 11 mm. or 15 mm. carbons.

VENTILATION OF THE LAMPHOUSE (Basic):

The ventilation of the lamphouse shall be so designed that the lamphouse will be able to handle as high as 150 amperes without detrimental heating, this to be accomplished with minimum draft at the carbon arc so as not to impair the arc steadiness. (See Note, "Flicker.")

SPEED OF MIRROR (Basic):

Interchangeable mirrors with speeds capable of filling F2.0 and F1.6 projection lenses shall be provided.*

ADJUSTMENTS (Basic):

The mirror shall be provided with universal adjustments so constructed as to maintain their settings.

DISTRIBUTION OF LIGHT ON THE SCREEN (Basic):

An optical system should be developed to provide a more uniform distribution of light on the screen than is now obtained from mirror type lamps. (See "Capacity of the Feeding Mechanism.")

Recommendations Applying Only to the Condenser-Type Lamphouse

CAPACITY (Basic):

The lamphouse shall be designed and constructed to accommodate 13.6, 16, and 18 mm. carbons, and to accommodate in the case of the relay set up, condensers capable of filling an F1.6 lens and cover the camera apertures as specified under "The Film Gate and Projector Head."

ADAPTABILITY (Basic):

The condenser lamphouse shall be so designed that it will be adaptable to a relay condenser system at such time as this system may be desirable.

(Auxiliary): In the opinion of the Committee, the basic recommendation on "Adaptability" will probably call for greater latitude in positioning and adjusting of condensers, and it has been suggested that the front end of the lamphouse be so constructed that it will be adjustable to accept different types of optical systems as well as those existing at present and those expected to be developed in the future. One method suggested has been the use of an adapter plate or series of rings on the front of the lamphouse which will allow, at the present time, a stepping down of the size of the opening in the front of the lamphouse to present systems, and the addition of faster systems, at a later date, merely by removing the adapter plates or rings.

VENTILATION OF THE LAMPHOUSE (Basic):

The lamphouse shall be so designed that sufficient ventilation will be provided for the use of currents as high as 250 amperes without detrimental heating, this to be accomplished with minimum draft at the carbon arc so as not to impair the arc steadiness. (See Note, "Flicker.")

Feeding Mechanism and Accessories (Applying to Both Type Lamphouses)

CAPACITY OF, AND TOLERANCES IN, LIGHT VARIATION FROM THE FEEDING MECHANISM (Basic):

The carbon feeding mechanism shall be designed so that the light projected on the screen is not subject to periodic changes of level attributable to the feeding mechanism (see "Light Variation") and must be capable of handling the carbon sizes specified under "Capacity."

TOLERANCES (Basic):

Feed and contact brushes for the positive carbon shall be so designed and made that the crater, during operation, will not change its focal position by more than ±0.025″. The positive head shall be designed so that the positive carbon axis at the crater will rotate within a circle of a radius of 0.010″.

BURNING POSITION OF CARBON (Basic):

The feeding mechanism shall be so

*NOTE: Present mirror reflectors do not produce adequate results in an F2.0 or F1.6 system and efforts to improve this condition should be made.

designed that the negative carbon will burn at an angle, in relation to the axis of the positive carbon, to obtain optimum efficiency. With present equipment and carbons this angle is approximately 53°.

FEEDING CONTROL MECHANISM (Basic):

An automatic control for the proper motor feed shall be provided to keep the crater in its correct burning position. Electrical feeds shall be provided for both carbons of sufficient latitude and control that the carbons may be motor-driven under all burning conditions after having once been set in the burning position, this to be accomplished by the use of separate independent motors for the automatic drive of both carbons, with alternate control for both positive and negative to permit hand feeding, both backward and forward, when desired.

(Auxiliary): It has been suggested that the automatic control for keeping the positive carbon in a correct relative position (basic recommendation above) be met by the use of a thermostatic or photo-electric cell control on the motor feed, either control to be actuated by a beam of light from the crater of the arc.

FEEDING MECHANISM ADJUSTMENT (Basic):

The negative feed mechanism shall be provided with a readily accessible adjustment to *move it both vertically and transversely in relation to the axis of the positive carbon.*

(Accessory): *Consideration should be given to the possibilities for providing a visual target to show the negative carbon burning position along the longitudinal axis*

(TO BE CONTINUED)

MANY CHANGES IN N.F.P.A. PROJECTION REGULATIONS

(*Continued from page* 15)

as to size and location. At least one should be of the conventional stairway type, having a suitable landing at the top or should open directly onto a corridor.

(d) Two openings for each *motion picture projector shall* be provided; one for the *projectionist's* view (*observation port*) shall be not larger than 200 *square* inches, and the other through which the picture is projected (*projection port*) shall be not larger than 120 *square* inches.

(e) Each opening shall be provided with *an approved* gravity shutter *set into guides not less than one inch at sides and bottom, and overlapping the top of the opening by not less than one inch when closed. Shutters shall be of not less than* 10-*gauge iron or its equivalent, or of* ¼-*inch hard asbestos board. Guides shall be of not less than* 10-*gauge iron or its equivalent.* Shutters shall be suspended, arranged and inter-connected so that all openings will close upon the operating of some suitable fusible or mechanical releasing device, designed to operate automatically in case of fire or other contingency requiring the immediate and complete isolation of the contents of the enclosure from other portions of the building. *Each shutter shall have a fusible link above it, and there shall also be one located over each upper projector magazine which, upon operating, will close all the shutters.* There shall also be provided suitable means for manually closing all shutters simultaneously *from any projector head and from a point within the projection room near each exit door.*

(f) All shelves, furniture and fixtures within the enclosure shall be constructed of incombustible material. *Tables shall conform to paragraph* 117.

Arc Lamp Ventilation

(g) Ventilation shall be provided by *one or more mechanical exhaust systems which shall draw air from each arc lamp housing and from one or more points near the ceiling. Systems shall exhaust to outdoors either directly or through a non-combustible flue used for no other purpose. Exhaust capacity shall not be less than* 15 *nor more than* 50 *cubic feet per minute for each arc lamp plus* 200 *cubic feet per minute for the room itself. Systems shall be controlled from within the enclosure and have pilot lights to indicate operation. The exhaust system serving the projection room may be extended to cover rooms associated therewith such as rewind rooms. No dampers shall be installed in*

such exhaust systems. Ventilation of these rooms shall not be connected in any way with ventilating or air conditioning systems serving other portions of the building.

(h) *Exhaust ducts shall be of non-combustible material, and shall either be kept one inch from combustible material or covered with ½ inch of non-combustible heat insulating materiol.*

(i) *Fresh air intokes other than those direct to the open air shall be protected by approved fire shutters arranged to operate automatically with the port shutters.*

(j) *Provision shall be made so that the auditorium lights can be turned on from inside the projection room and from at least one other convenient point in the building.*

[NOTE.—Automatic sprinklers in projection *rooms* have been very successful in controlling fires and reducing losses, and their installation is recommended wherever practicable.]

193. Processing of Film. The processing of film, as cleaning, polishing, buffing and other special treatments, shall not be *one* in rooms *where* other operations *are performed, except that in motion picture theatres, cleaning of film may be done in the rewind room.*

PART II. SPECIAL PROVISIONS FOR SPECIAL OCCUPANCIES

Section 21.—Motion Picture Theatres and Other Occupancies In which the Principal Use of Film Is in Motion Picture Projection

211. Enclosure for Projectors. Motion Picture Projectors shall be installed in *an enclosure* in accordance with subsection 191.

212. Rewinding. (a) Rewinding of films shall be performed *either* in a *special rewind* room at an approved location, or in the projection *room. If done in the projection room, approved enclosed-type rewind machines should be used. An approved can for scrap film having a self-enclosing hinged cover shall be provided.*

(b) *Rewind rooms shall be at least* 80 *square feet in area, with walls and doors in accordance with the requirements of subsection* 112 *and with ceiling of equivalent fire resistance, and shall have a vent to the outside of the building of not less than* 27 *square inches. See paragraph* 191 *(g). Exhaust ducts shall comply with paragraph* 191 *(h). Shelves, furniture and fixtures shall comply with paragraph* 191 *(f).*

213 (a). *Change word "booth" to "room."*

(1) *Omit words "booth or".*

(3) *Omit words "or room".*

(4) *Change word "booth" to "room."*

214. No collodion, amyl acetate or other similar flammable cement or liquid in quantities greater than *1* pint shall be kept in the projection booth *or room* or rewinding room.

215. *Splices in film shall be made on mechanical cutting and splicing machines. See paragraph* 212 *(a) on handling of scrap film.*

217. Operation. *Motion picture projectors shall be operated by and be in charge of qualified projectionists, who shall not be minors.*

218. Procedure in Case of Fire. *In the event of film fire in a projector or elsewhere in a projection or rewind room, the projectionist should immediately shut down the projection machine and arc lamps, operate the shutter release at the nearest point to him, turn on the auditorium lights, leave the projection room, and notify the manager of the theatre or building.*

COPPER-SULPHIDE RECTIFIER

(*Continued from page* 11)

why we are very careful to prevent moisture and air from getting to it.

MR. FINN: What is meant by "a useful life of five years"?

MR. KOTTERMAN: The life under operation conditions, depending upon the use of the equipment. It might be perfectly all right at the end of five years. We have rectifiers delivering much smaller outputs than the carbon-arc rectifier demands which have been in service ten years.

MR. FINN: The General Electric Co. ran some accelerated life-tests on the copper-oxide type of rectifier equivalent to ten or eleven years of continuous service.

The phrase "useful life of five years" does not seem right. If General Electric ran those for ten years, exposed to all sorts of weather conditions, I do not see why this particular rectifier should be limited to a useful life of five years, pro-

vided the safety factor remains constant. I know that some railroad rectifiers have been running ten years.

MR. KOTTERMAN: We have been making this heavy-current type of construction only about two years, and the only thing we could do was to have an accelerated life-test, which we think is equivalent to five years. We stopped it at the end of that period in order to study the rectifying junctions. We have started another life-test that we may run an equivalent of ten years.

MR. FINN: We are not dealing with high amperages, only 50 or 60 amperes.

MR. KOTTERMAN: I think that is a rather high current. It means that the copper-sulfide rectifier is operating at a current-density of 38 amperes per square-inch.

I might qualify the term "useful life." One buys an automobile and expects a useful operating life of three years. It may continue to operate after that, but might not be quite as useful as it was during the first three years. Conceivably this rectifier may still operate at the end of five years and still be useful; or the voltage output may fall off to the extent where it is no longer giving useful service for the projection arc.

DR. CARVER: What happens when the rectifier does go bad? Does it go bad suddenly, or does it give warning?

MR. KOTTERMAN: It gives warning. The output begins to fall off.

MR. ROBERTS: What is the voltage drop through the rectifier unit on an arc application? What is the efficiency of the unit?

MR. KOTTERMAN: The rectifying efficiency of this type of copper-sulfide rectifier is 50 to 55 per cent. Depending upon the circuit conditions, the overall efficiency of the transformer-rectifier combination would be lower than the rectifying efficiency alone.

MR. ROBERTS: What is the drop through the unit?

MR. KOTTERMAN: One-half volt per junction.

MR. CRABTREE: What is that in comparison with the copper-oxide rectifier?

MR. ELDERKIN: The copper-oxide rectifier gradually ages. The output drops from the time it is new until you can not use it any longer. The resistance increases steadily; sometimes it will be so high as to cause overheating. This rectifier does not do that. It does not age. The efficiency is the same throughout a longer period of life. The copper-oxide rectifier will show a little higher efficiency at the start, and lower efficiency when it is older. The average efficiency over a given length of time will about be the same for the two.

MR. CRABTREE: What is the ratio of input to output?

MR. ELDERKIN: That depends upon the

(*Continued on next page*)

RCA SERVICE FOR 67

RCA has signed sound system servicing contracts covering 67 theatres of both Saenger Amus. Co. and United Theatre groups, extending through five states.

BIG FOX COLOR SCHED.

At least 6, and possibly 7, Technicolor features will be made by Fox-20th Century on its 1939-40 program, the largest single season's color group ever to be made by a major company. Technical is aiming at a grand total of 50 features for next year.

circuit, the output, and the number of units used. In this particular application the efficiency will start at 60 to 65 per cent; with the copper-oxide it will drop to 40 or 45 per cent.

Chief Advantage of Unit

MR. KOTTERMAN: In our opinion, the chief advantage of the copper-sulfide rectifier over the copper-oxide rectifier is its tremendous reserve capacity and the fact that it operates at an exceedingly high temperature without causing destruction of the rectifier elements. Also, that we can build a rectifying device that will deliver the amperage associated with the carbon arc in a very small assembly.

One form of copper-sulfide rectifier measures 16 inches in diameter and 12 inches in height, weighs 100 pounds, and delivers 10 kw. of direct current. Of course, those figures do not include the transformer. I do not think there is any type of contact rectifier or other type of d. c. generator equipment that can deliver 10 kw. in so small a compass as that.

MR. THOMAS: What are the characteristics of this equipment on 25-cycle current, and what happens to the d. c. output in relation to an a. c. input voltage drop?

MR. KOTTERMAN: Laboratory measurements have shown very little difference between the overall efficiency at 25 cycles and at 60 cycles. Much larger transformers are required to operate on 25 cycles than on 60, but the results are practically identical.

Comparative Portability

MR. STRICKLER: We use from 50 to 100 of the tungar outfits for portable projection, travelling all over the country and encountering all kinds of conditions. The weight and size are very important. We have small arc lights using about 25 amperes. Would your rectifier be less in weight or in bulk than similar contact outfits? Single-phase supply is what we meet in almost all cases.

MR. KOTTERMAN: For single-phase operation I doubt that there would be much advantage as to size or weight over the tungar equipment. However, for polyphase operation there would be.

MR. STRICKLER: We are not so much interested in efficiency because we are in operation only for an hour or so at one time; but when a man has to set up a complete outfit in ten or fifteen minutes, equipment weighing 500 pounds in cases, put on a show in a room similar to this, tear down the equipment and put it into cases; and then put on another show in the afternoon of the same day several miles away, we have to consider size and weight. Our present units are stripped down to about 50 pounds per case. Would such capacity be possible with your outfit of similar size and weight?

MR. ELDERKIN: The rectifier units required, according to the voltage, would obviously be heavier than the equivalent number of tubes. Otherwise, the weight of the transformer, *etc.*, would be the same. The bulk would be greater.

MR. THOMAS: Does the reserve of the rectifier compensate for a. c. line fluctuations?

MR. KOTTERMAN: No; that is a matter of transformer design. With sufficient reactance in the transformer you will maintain reasonably constant d. c. output under wide variations of a. c. voltage. A 10-volt variation in a 220-volt line might cause a variation of only 0.5 to 1 volt in d. c. output. Some very recent developments using highly reactive transformers are better than that.

MR. THOMAS: What happens when we strike the arc? Does the voltage jump, and then return to the proper value for operating the arc?

MR. KOTTERMAN: To answer your question completely and accurately it would be necessary to put an oscillograph on the output of the rectifier.

However, I have measured the current at the instant of striking the arc, and have found it to be of the order of 200 amperes. However, that only lasts but a fraction of a second, and immediately the carbons are separated the current and voltage return to normal.

Possibility of Overheating

MR. FIFERLIK: Is the rectifier likely to heat up if connected when the arc is not burning?

MR. KOTTERMAN: The rectifier for the projection arc or any other heavy-current application can withstand normal line-voltage input without suffering damage in any way. The leakage current of the copper-sulfide rectifier is much higher, of course, than that of the copper-oxide rectifier, but is not high enough to result in any dangerous temperature.

MR. DASH: With regard to "useful life," I should like to mention that there are motor-generator sets in operation in theatre service that have had 20 years of useful service, and are still operating well. The presence of rotating parts does not limit the life of equipment if the equipment . well designed.

MR. CUTHBERT: Is there any disadvantage in breaking the d. c. circuit instead of breaking, as you normally do, the a. c. rectifier circuit?

MR. KOTTERMAN: It is more desirable, of course, to break the a. c. circuit because it is more sensitive to excess voltage than other types of contact rectifiers. But as I have said, we endeavor to engineer into each rectifier application the correct electrical characteristics so that if you do break the d. c. side or operate it under the other circuit conditions, it will stand such operation without harmful results.

INTERNATIONAL PROJECTIONIST

JULY 1939

VOLUME 14 • NUMBER 6

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You wouldn't wear this suit on a Modern Beach

But are you using an old-fashioned sound system on modern movies?

Here's an important fact to remember—Hollywood is now producing finer sound than ever before—because movie fans demand good sound. To properly reproduce it—and build up your business—install

New RCA Photophone Magic Voice of the Screen

with Rotary Stabilizer plus Shock-Proof Drive

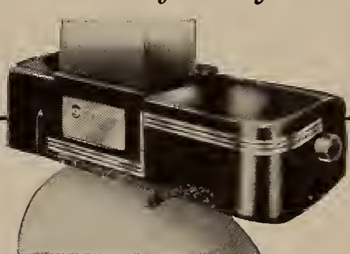
—available at low cost to theatres of every size!

LET'S LOOK AT FACTS. You can show the finest pictures in the world—but you'll have empty seats in your theatre if the sound is poor. Because nowadays movie fans know good sound from bad—and patronize the theatre where listening is as much fun as looking.

Hollywood knows this and that's why Hollywood puts such excellent sound on its films. But how about you—are you letting an outmoded sound system hurt your takes?

It will pay you to find out about the *new* RCA Photophone Magic Voice of the Screen. For here's the equipment built for true reproduction of modern movie sound. It's the tonic your box office needs. And its low cost will surprise you, just as its many new features will delight you. Full details from your RCA Photophone representative.

RCA Photophone's service organization has a low cost theatre service plan in which you'll be interested



Only the New Magic Voice of the Screen offers all these Features!

This splendid new equipment gives you full assurance of constant film speed by adding the amazing new Shock-Proof Drive to the famous Rotary Stabilizer! Besides this great feature, the new Magic Voice brings you new styling, new protection, new convenience, new added reserve power and many other outstanding *proofs* that it's the best value you've ever seen! Ask your RCA Photophone representative for complete information.

Better sound means better box office—and RCA tubes mean better sound.

RCA Photophone

MAGIC VOICE OF THE SCREEN

RCA Manufacturing Co., Inc., Camden, N. J.—A Service of the Radio Corp. of America

International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

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Monthly Chat

REPEATED requests from projectionists for information relative to the new series of Bausch & Lomb $f/2.0$ projection lenses induce this corner to pass along the statement of the manufacturer that details anent this new series will not be forthcoming until late Summer or early Fall. We'd like it to be otherwise, but we can hardly break into the B. & L. plant and seize the data.

• • •

Elsewhere herein is a summary of theatre television development as sponsored by the Baird people in England. This summary should serve to soothe the frayed nerves of some of the more jittery projection men, particularly those who have been reading in other journals about current telecast images "approximating" the quality of feature film releases of "a few years ago."

• • •

Several responses to the suggestion that the P. A. C. be revived have been received; but this corner detects no flowering of unrestrained enthusiasm anent the idea among the craft at large.

• • •

We've cleared our throat preparatory to shouting "I told you so" with respect to the campaign by the distinguished Mr. F. H. Richardson in favor of shipping "tails out" prints to theatres. Our scouts report that the exchanges, as forecast herein, have taken advantage of this practice to give prints even less inspection than heretofore—which adds up to a figure approximating zero. "F.H.," fortunately for him, doesn't have to run such prints.

• • •

Two significant items culled from the industry news: 610 projectors are in use in Chicago schools. 590 shorts with sound accompaniment have been made available by the M.P.P.D.A. for school use. Now, if somebody would compile a list of other non-theatrical showings for which admission is charged, and also ascertain the source of product for these itinerant exhibitors, movie theatres might be better able to cope with this growing problem.

• • •

No little confusion exists among projectionists relative to properly classifying the many and varied types of sound track now in general use. An attempt to settle the dust hovering over this question will be assayed by I. P. if ever a certain Mr. Kelly of Hollywood can be dragged back from Malibu and put to work.

• • •

No reader has yet threatened to shoot us for sponsoring the current series of articles on mathematics by the capable Mr. George Logan of the M-G-M studios, thus we hazard the guess that he's putting over his stuff.

We've essayed this task of 'selling' math on two previous occasions, with results that we elect to forget about. Any comment on the current series?

INTERNATIONAL PROJECTIONIST

VOLUME XIV NUMBER 6

JULY 1939

Supplementary Aids to Servicing Sound Reproducing Systems

By *LEROY CHADBOURNE*

WHEN all other sources of sound system data have been exhausted (see I. P. for March, 1939, p. 12; and April, 1939, p. 7) the physical apparatus can be inspected and its wiring traced, schematic and other diagrams then being drawn accordingly. This is not an easy job; it is difficult, tricky, and takes time. It should never have to be done in the projection room. However, there are three sets of circumstances that may make this work necessary, even indispensable.

First and most serious is when provision of proper drawings has been delayed until after the arrival of trouble of such nature that it can't be fixed without the aid of drawings. The only consolation here is that the necessary diagrammatic information can usually be restricted to one very small area of the system, where the trouble has previously been isolated by suitable tests made at marked connection points. Small or large, however, simple or complicated, the faulty part of the system often has to be drawn out on paper before the circuit arrangements can be understood and the trouble diagnosed accordingly.

It goes without saying that the drawing of diagrams delays trouble-shooting, and should not be left until after trouble appears. There are consequently two other occasions, which do not involve immediate trouble, when drawings may have to be made to assure their availability when needed.

The most common of these is where there is doubt as to the accuracy of such drawings as are available. Changes may have been made after the equipment was installed and *not properly recorded on the diagrams.* This often happens, and when it does the drawings are worse than useless: they not only fail to lead the trouble-shooter down the right path but misdirect him into a dead end. The same result ensues when original data have been damaged, worn out or mislaid, and new ones, obtained from the manufacturer, show subsequent modifications and improvements that the apparatus installed doesn't have. Physically checking the wiring, in advance of trouble, is the only real remedy.

Finally, there are theatres that cannot obtain drawings, either because the manufacturer has gone out of business or because he has changed models and no longer has spare diagrams of the old ones, or (as still is unfortunately the case) he refuses to supply drawings.

Any of the aforementioned circumstances puts an unpleasant but unavoidable job squarely up to the projectionist. The job is not without its compensations: he who handles it is likely to know the circuits of the system from then on.

Most theatres buy sound service; still, system data should be in the projection room. If it is not, the projectionist can do little or nothing except wait for the service man—which means

that meanwhile the theatre is out of luck. With diagrams, the projectionist, even if he doesn't find the trouble, can at least eliminate false leads and save the serviceman that much time. Further, absence of data makes breakdown more likely: the projectionist can hardly be expected to put a correct interpretation on symptoms of coming trouble or to take needed precautions, if the circuits are a mystery.

● Types of Drawings

Drawings that may have to be made in a projection room can be divided into the two categories of external and internal circuits. Fig. 1 represents the external circuits of a portion of a modern sound system. Fig. 2 shows the circuits of a modern amplifier (not part of the system shown in Fig. 1).

External circuits are the easier to trace. In time of trouble they are fully as important as internal circuits, perhaps more so, since it is often necessary to apply tests to Fig. 1 in order to isolate trouble to the interior of some such panel or cabinet as Fig. 2. At the same time, Fig. 1 naturally can give trouble on its own account.

Circuits corresponding to Fig. 1 are usually easy to obtain. All manufacturers now supply them with new equipment as a guide in doing the preliminary work of installation. Not all are as complete as Fig. 1; some do not show the terminals to which each individual wire connects. All are valuable, however, should be kept after installation is completed, and modified to make them complete if necessary. Corresponding drawings of older systems may not be available; if obtained on request, they may not represent the true situation, and should always be checked.

● Safe and Unsafe Testers

Amplifier schematics of the type of Fig. 2 cannot always be obtained even for new systems, and are not always accurate. Some types of amplifiers, having proved satisfactory, are supplied by the same manufacturer over a period of years, usually with slight changes from time to time. There may be a series of such amplifiers (or other units) all pretty much alike but different enough to produce great confusion when trouble is traced through one with the help of a diagram that applies to another. Drawings not shipped with the equipment at the time of original installation are always under

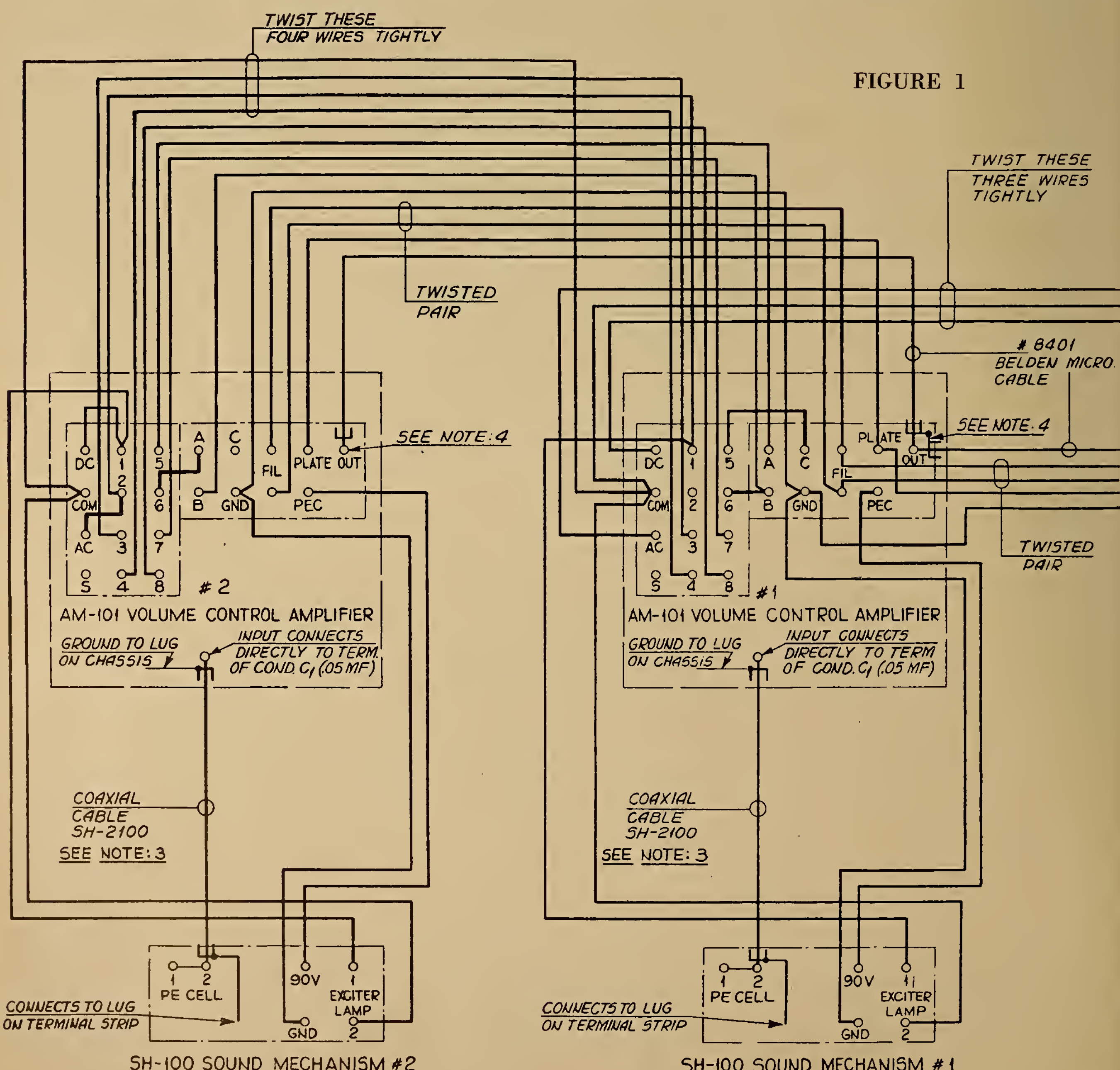


FIGURE 1

suspicion and should always be checked.

In drawing a diagram from actual apparatus a satisfactory circuit tester is the most important appliance needed, aside from paper and pencil. Bell and buzzer are *not* satisfactory testers for any kind of sound work. Neither is a trouble lamp. The smallest size ½-volt flashlight bulb and corresponding battery are reasonably safe if not used on photocell coupling transformers. Headphones and battery are almost always safe to use. Aside from partial or complete undesirability, however, none of these testers gives full information, and relying on them needlessly complicates the work.

Those of the aforementioned testers that permit the passage of more than a few mils of current (buzzer and battery, etc.), may permanently magnetize the core of a coupling transformer. As everyone knows, a bell-ringing transformer, for example, will not couple sound circuits satisfactorily. It is designed for 50 or 60 cycles, losing efficiency at other frequencies; while a good sound transformer must be equally efficient from 40 to 10,000 cycles. The type of metal used for core, and its degree of magnetization, is very important in this connection. Saturating the core by passing through the windings currents much stronger than they were ever intended to carry may result in permanent damage to sound quality, and very difficult to run down in a projection room.

Crude testers of this type also give insufficient information. A high-resistance circuit, such as the 100,000-ohm input of Fig. 2, is likely to show up as an open circuit with such devices. A low resistance, such as the 33-ohm meter resistor in the plate line of the first tube of Fig. 2, is likely to show up merely as a connecting wire. This does not mean that the headphones or very small flashlight bulb cannot be used, if nothing better is available, but they complicate the job needlessly.

The ohm-meter, or as second choice a battery and high-resistance voltmeter, are always to be preferred.

Further, a soldering iron is needed. Refer to Fig. 1. The "Com" terminal of the right-hand volume control amplifier (about the center of the drawing) carries three wires which go to different points. One of them touches at the "Com" terminal of the left-hand volume control amplifier, so that altogether there are at least four terminal studs in this system which are wired together. Still other studs may link on by reason of internal connections through switches or other junctions inside of a panel; for example, the third output wire from the top, at the right of Fig. 2, is internally united with the sixth output wire from the top.

Where the wires go into a cable form, or a conduit, so they cannot be seen and traced by sight and hand, such linkages make the process of drawing a circuit extremely difficult, unless the terminal connections are temporarily opened with a soldering iron.

In some cases several connections may have to be opened simultaneously, to make sure the apparent indications are truly accurate. Wherever this is the case, every wire *must* be tagged to make sure it goes back at the right terminal. No easier method of blowing out an amplifier has ever been invented than trusting to memory in a matter of this kind. The tags may be mere scraps of paper poked on the wire, each having first been carefully inscribed with the necessary information. Small "price tags," bits of cardboard with string attached, can be had in any stationery store at 10c a hundred. They do not tear, and are in every way superior.

A group of tags of any kind should never be marked up in advance and then put on wires one by one. That is how they get on the wrong wires. Each one should be marked at the last minute before it is attached. The string type can, and should, be put on its wire before the wire is disconnected from its terminal.

The process of checking an existing diagram, such as Fig. 1, is not very different from that of making a new diagram. Merely checking the wires one by one against the drawing in hand is likely to lead to error. There is a natural tendency to believe that conditions are as the drawing represents them, and oversight becomes easy. It is better to make a new drawing which is then compared with Fig. 1, using that diagram, however, as a guide to facilitate the work without relying on it completely.

The same is even more true of Fig. 2. Consider the left-hand side of the choke coil shown above and just right of the filament of the rectifier tube. Ten different parts (seven resistors and three condensers) connect directly to the left-hand side of that coil. Possibilities of confusion are obvious. The only safe way is to mark down the connections as the ohm-meter shows them, and check the diagram afterward against the drawing thus made, rechecking where discrepancies appear.

It is helpful of course to use the existing diagram as a guide, without trusting it very much. But it is futile to check the ten connections one by one, referring to the diagram each time and approving it before going on to the next connection. That is trusting memory too far. A separate drawing should be made.

In other words, checking a drawing and making one are about the same process, except that in the former case reference to the diagram already at hand helps speed the work.

● Tracing External Circuits

In tracing arrangements of the type of Fig. 1 experienced men generally begin by drawing all the terminal blocks, with each individual terminal post and its designation as shown on the physical equipment. Where the equipment is not marked, care is taken to draw every terminal post in exactly its correct position. Where chances of confusion are great, by reason, for example, of crowding, a red crayon is sometimes used to number the terminal points in the actual equipment, corresponding numbers being set down on the paper. *Nothing* is trusted to memory—nothing.

When the terminal posts have all been properly drawn and identified, the work of tracing wires begins. It involves two processes. One is straight tracing with the ohm-meter or other instrument. The other involves some temporary guessing, always confirmed by the tester, intended to make the work easier.

With the arrangements of Fig. 1, work may begin at any convenient point, which might be PEC terminal 1 in No. 1 soundhead. The jumper to terminal 2 of that PEC connection is obvious. The coaxial cable connection to No. 1 volume control amplifier is also obvious. The other four connections between No. 1 soundhead and No. 1 volume control amplifier may also be visible, or conduit may be buried in the floor and wall, connecting with the projector base. If so, the wires may go anywhere; the conduit vanishes in the floor, but a little guessing, based on switching arrangements and general probabilities, is in order, and No. 1 volume control amplifier will very likely be checked first.

The details of investigation are, however, very different when the connections are subject to some visible check and to instrumental inspection only. The easier case, that in which eye and hand can supplement the instrument, may be considered first.

Work may begin almost anywhere say with No. 1 soundhead. Four wires can be seen, running to No. 1 volume control amplifier. The markings on the terminal board of No. 1 control amplifier offer some further help. Finally, the ohm-meter shows definitely that there is a solid connection between No.

1 exciter terminal in the soundhead and No. 1 terminal in the amplifier.

The only question remaining is: does that connection arrive directly from the soundhead, or indirectly through the other wire also tied to amplifier terminal No. 1, or indirectly through some other amplifier terminal and the amplifier's internal circuits? Tugging and observation may help here, but the only certain assurance is provided by tagging the two wires on No. 1 terminal and removing them; then testing the terminal itself and each wire singly, with the ohm-meter.

The true connection thus found is properly added to the new drawing. The wires are not replaced immediately; they are tagged and will not go back on the wrong terminal, thus avoiding excessive connecting and disconnecting.

Similar procedure is then followed anent the other three wires, until all the output connections from soundhead No. 1 have been traced and set down on paper. The ground connection alone is left unchecked; grounds are linked in so many ways, not only by wire but through conduit and any other metal work that may be handy, as to make tracing them a difficult business seldom undertaken except to run down a "ground loop" that is causing line frequency hum. Mere addition of the ground symbol is sufficient for most other purposes.

Information gained by tracing No. 1 soundhead connections will aid in investigating the other head—but only as a guide. A short inspection of Fig. 1 will show that the two circuits are not at all alike in some details. The wiring of No. 2 head is traced *separately*.

When conduit runs are concealed, or when they link on to other conduits, the work becomes much more difficult. Consider the line leading from No. 1 exciter terminal of No. 2 soundhead. Careless use of the ohm-meter might indicate a direct connection to the d.c. terminal of No. 2 volume control amplifier. This is not the case. The difference is unimportant with respect to current, but may be very important to a trouble-shooter looking for a break or a short.

The first job is to find the conduit that comes from No. 2 soundhead. This may be done by considering pipe sizes, counting the number and kind of wires in each pipe, and tugging the wires; and in very extreme cases by unsoldering a whole set of wires after they have been properly tagged, and then pulling back. All of the wires thus identified are unsoldered from all terminals and from each other, and individually checked with the ohm-meter. If the system has been properly installed, with no splice in any conduit, there is no chance of mistake. As a further check, couplings may be opened and wires tugged.

If there are splices inside a conduit, which cannot be seen or reached by opening couplings, the case may be hopeless. Systems so installed have on occasion developed troubles that proved incurable, yielding only after all wiring had been pulled out and reinstalled properly. Assuming, however, that the equipment was correctly put in, a correct drawing can be made of its connections, even with completely concealed conduit, provided proper precautions are taken.

As the work proceeds wires that have been fully identified, and cannot possibly contribute confusion to other circuits, may be restored to their proper terminals. Thus, in Fig. 1, the input circuits to the volume control amplifiers can be restored when only the output circuits are left to trace.

Some sound systems are so simple that their external connections, including stage wiring, can be traced down in an hour or two. Some are so complex that the work may require several nights. When the work is done in advance of trouble, it can be done a small bit at a time; but of course very little of it can be done while a show is running.

● Tracing Internal Circuits

An internal circuit, similar to Fig. 2, is more difficult to trace because of its greater complexity, one item of which has already been mentioned, but often easier to check because wires are likely to be color coded. Wires that are not bound in cable forms can be traced visually and by hand. Wherever there is the slightest doubt, the ohm-meter is used for confirmation.

The most convenient procedure gen-

(*Continued on page* 25)

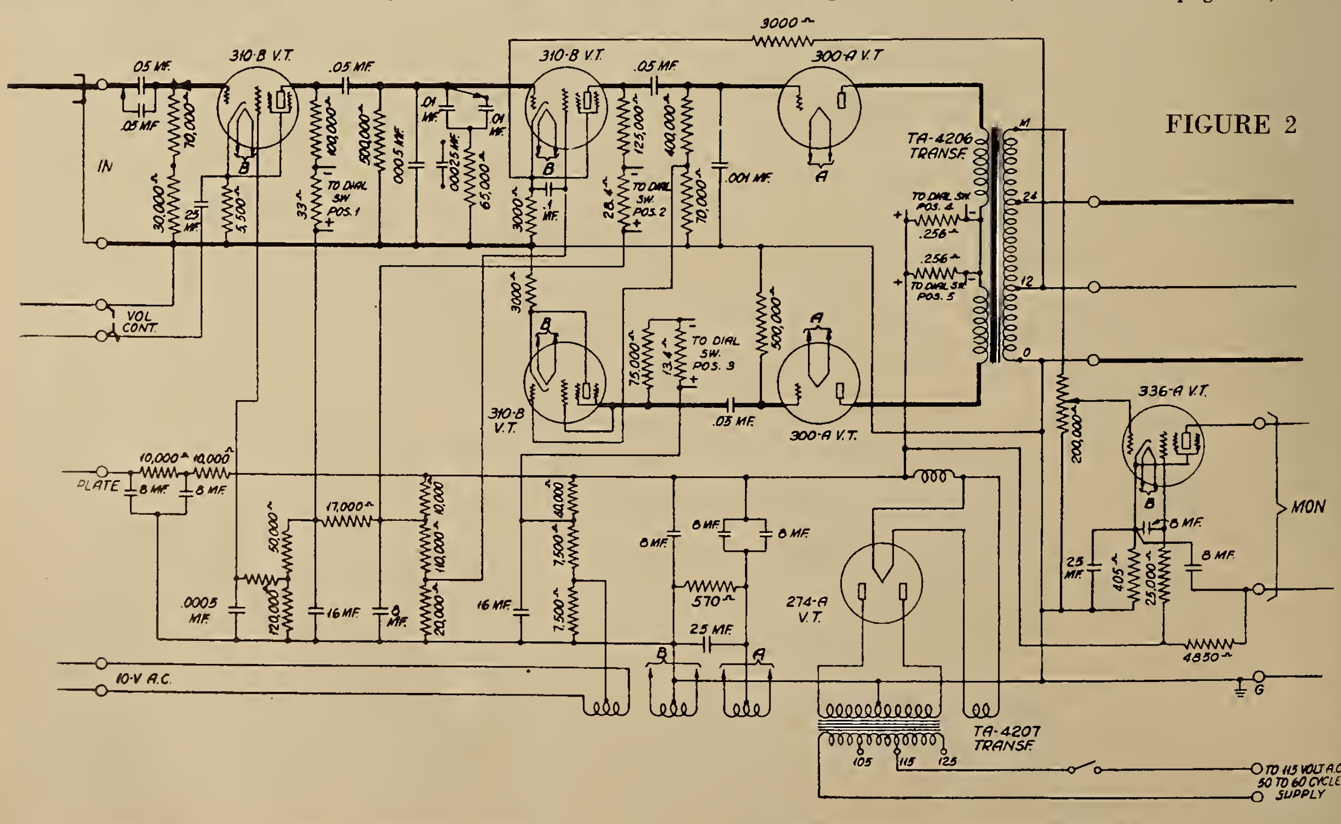


FIGURE 2

Two Standout Projection Aids

Practical Projectionists Wrote This Ad!

BALABAN & KATZ CORPORATION
EXECUTIVE OFFICES
CHICAGO THEATRE BUILDING
CHICAGO

May 13, 1939

Essannay Elec. Mfg. Co.
908 South Wabash Avenue
Chicago, Illinois

Gentlemen:

The splendid service rendered by the Strong Zipper Changeover prompts the writing of this letter. We consider a reliable changeover as among the most important projection accessories; and among all changeovers we have concluded that the Strong Zipper tops them all.

This was forcibly brought home to us during the recent showing of "Union Pacific" at this theatre. During this performance we were continually going from our standard-size picture to a "blow-up" of twice our regular screen size. The Strong Zipper Changeovers, with which we equipped our three Simplex projectors more than a year ago, performed perfectly and enabled hair-trigger changeovers.

Not only is the Strong Zipper reliable in performance, but it is extremely simple in construction and very easy to install. Your treadle footswitch, which completes the unit, is the best which we as projectionists have ever seen or used.

Having been consistent users of Strong changeover devices for the past 17 years, ever since the opening of this theatre, we are very glad to attest to the excellence of your changeover to the practical projectionist.

Martin Johnson E. Glenn Sweeney
Harry Ragan Robert P. Burns
Seth O. Noble

Projection Staff, Chicago Theatre, Chicago, Illinois

For Perfect Changeovers —
The STRONG ZIPPER

Announcing

A New and Wholly Different

Reel End Signal

that does not touch the film or reel.

This new device is strictly mechanical and requires no batteries, no transformers, no governors, and no presetting by the projectionist. It does not touch the film or reel, and it is not dependent upon any change in the normal smooth operation of the projector.

One minute before the end of a reel this Reel End Signal gives a clear, distinct signal of 15 seconds duration—then it stops. Simply yet sturdily constructed, this Reel End Signal has performed its intended function unerringly in more than 1000 tests under practical conditions in various theatre projection rooms.

Installed in 5 minutes, the Reel End Signal has no component to get out of kilter or require any adjustment. Orders accepted now for delivery July 30 and thereafter. A complete description will appear in the next issue of this publication.

Orders for the Reel End Signal have already been placed by several large theatre circuits, including Paramount, which approved the device immediately upon its first demonstration.

ESSANNAY ELECTRIC MANUFACTURING CO.

Makers of Precision Projection Equipment for 25 Years

908 South Wabash Ave. Chicago, Illinois, U.S.A.

Panoramic Projection Equipment*

(USED AT PALACE OF LIGHT, INTERNATIONAL EXPOSITION, PARIS)

By *A. GILLETT,*** *H. CHRETIEN,*† and *J. TEDESCO*‡

FROM the very time of its inception the cinema art seems to have been beset by the rigid limitations implied by the use of an almost square frame, and the sound-track has only accentuated the inharmonious proportions of the screen projection. How is one to overcome the insurmountable limits imposed by the standard size of the film? Instead of a screen five to six meters wide (1 meter = 3.281 feet), it is possible to use, for example, a screen ten to twelve meters wide, but the height of the picture will increase accordingly, and what we shall see will be a more or less monstrous enlargement wherein the defects of the film, particularly the graininess, will appear grossly exaggerated.

Such attempts to get away from the convention system are prompted by a desire to be liberated from the limitations of the exceedingly narrow frame, to suit the diverse needs of an art the very essence of which is motion and space. The technical solution to the problem was not actually attained until the appearance of the French invention of Professor Chretien.

In discussing this subject, is must be pointed out that it is believed that projection of such dimensions has never before been realized, either in a theatre or outdoors. One of the largest projection screens was built and used by Lumiere in 1899 in the Galerie des Machines of the Paris Exposition. It measured 30 meters wide by 24 meters high and required a projection distance of 200 meters. This panoramic screen had an area of 600 square-meters, 60 meters long by 10 meters high. The largest screen constructed for a theatre is that of the Gaumont Palace, which has a normal area of 100 square-meters and may be enlarged to 200 square-meters when certain scenes of the film being projected permit a panoramic effect.

● Screen Requirements

To obtain sufficient brightness of the projected images, it is necessary, on the one hand, to use extremely powerful arcs and, above all, to consider the problem of the reflective power of the screen. After repeated trials the best results were obtained with a screen consisting of a cloth to which were attached small and perfectly spherical glass beads. However, a beaded cloth of such dimensions could not be practicable for outdoor use. It was therefore necessary to develop a screen capable of withstanding the weather, and it was decided to study the possibility of placing the beads on a wall instead of on a screen.

This particular screen consists, first, of a support a few centimeters thick, consisting of a mixture of lime and sand in adequate proportions. When dry, this support was covered with several coats of insulating varnish to prevent any possible reaction of the lime and sand support upon the screen proper. This coating of varnish was, in turn, covered with six successive layers of zinc white; and, finally, these layers were coated with an adhesive varnish onto which the beads were thrown by means of a special compressed-air gun.

The resulting screen is, of course, directional, having its maximum reflectivity within an angle of approximately 43 degrees. Outside the 43-degree angle the reflective power is reduced about one-half. Nevertheless, the screen at the Palace of Light, its present position, permits an audience of 4,000 persons, as a minimum, to enjoy the projection under excellent conditions of visibility and brightness.

One of the greatest difficulties was the problem of image brightness, and it was necessary to take into consideration the surrounding light, as adequate darkness within a radius of 200 or 300 meters around the Palace was entirely out of the question. However, the brightness of this gigantic image is even better than that obtained in many motion picture theatres using projection screens of average dimensions.

The screen was installed on the facade of the Palace of Light (Fig. 1), and was exposed to the weather during the period of the Exposition. The facade of the Palace, and the screen itself, were slightly concave, which helped to avoid the marginal distortion that would have occurred had the facade been flat, since the apparatus at the right projected the images on the left of the screen, and *vice versa.*

In order to project films of standard size (18 by 24 mm.) upon this large screen, standard, the surface of which measures approximately 600 square-meters, new methods, in addition to the use of a screen of great reflective ability, projectors of tremendous power, highly luminous optics, and so forth, had to be adopted. A special difficulty was encountered with respect to the shape of the screen, the width of which was six times the height, whereas the width of the film images barely exceeds the height. This difficulty was overcome by the use of two connecting projectors, each equipped with a special optical device known as the "Hypergonar."

● The Hypergonar Lens

The Hypergonar lens was invented in 1927 by Professor Henri Chretien, of

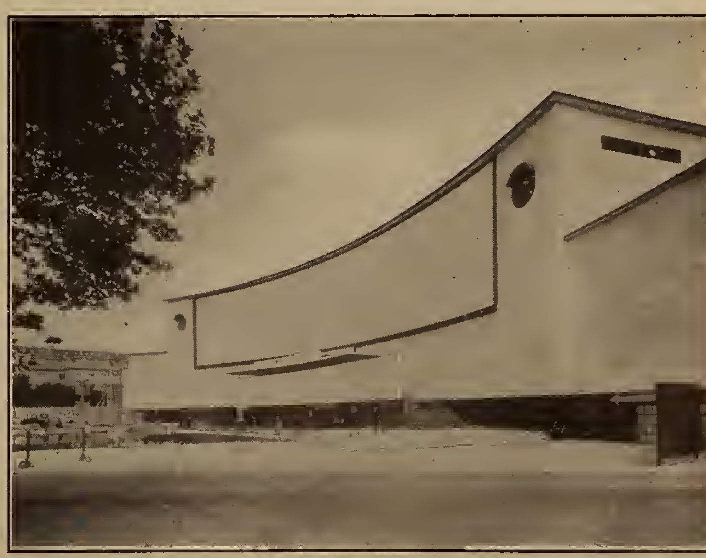


FIGURE 1 *Panoramic screen on the facade of the Palace of Light (Paris)*

*J. Soc. Mot. Pict. Eng., XXXII (May, 1939).
**Brockliss-Simplex, Paris, France.
†University and Optical Institute of Paris, France.
‡Paris, France.

the University and Optical Institute of Paris. It is a sort of optical transformer. It does not produce real pictures by itself, but if set before an ordinary photographic objective doubles the field of the objective *in one direction only*, which in this instance is horizontal.

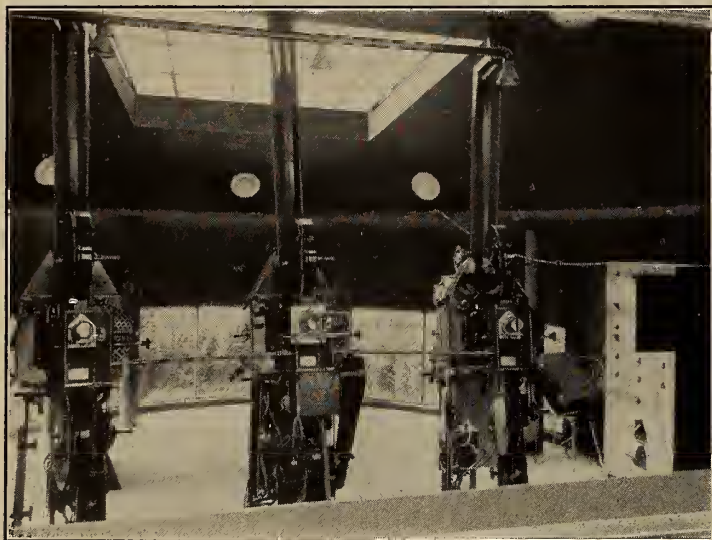


FIGURE 2

Arrangement of projectors showing interlocking scheme

A picture 24 mm. wide may thus be registered on a film that would normally require a 48-mm. picture. When the picture is projected, a similar optical device, placed before the projector, spreads out the luminous beams horizontally, thus restoring the objects to their proper shape. The lenses used are not of the ordinary spherical variety, but are cylindrical, and are more difficult to grind to the required degree of perfection than ordinary lenses.

The total field required to cover the huge screen was obtained by juxtaposing two partial fields, each having been previously doubled by means of the Hypergonar. A special camera-type base permitted the automatic connection of the two equipments in accordance with the focal length of the objectives used and made it possible to drive them synchronously by means of an electric motor.

As a result of the combination of these methods, it was possible to project upon the largest screen in the world, with considerable brightness, pictures that had been magnified *six hundred times* in height and *twelve hundred times* in width, or *seven million times* in area; and this was accomplished in spite of the general illumination prevailing in the surroundings.

Natural vision is thus reconstructed on the screen in a most remarkable manner. Instead of viewing the film through a narrow space—a square loophole—we see it unfolded before us as it would be in nature. No doubt many cinematographic effects are lost through such a panoramic extension, but it is no less true, on the other hand, that with this device many pictures are recreated and endowed with the "aeration" they likewise lack—the visual extension required to produce this effect, and, in short, the harmony and suppleness of expression of which the cinema had been long deprived—an art which from its very nature and scope was destined to develop freely and at ease after the panorama of nature and life.

Other Projection Adjuncts

The projection proper is provided by two standard Simplex projectors with rear shutters, which makes it possible to use 250 amperes per arc without heating the film dangerously. These are driven in synchronism by a third Simplex apparatus, identical to the others, through two universal couplings. The third projector carries also a Thompson sound reproducer (Fig. 2). The central projector is driven by a 1½-hp. motor.

Each Simplex projector is equipped with an "Ultimum" Taylor-Hobson, extra-luminous objective, with a fixed focus of 120 mm. and an aperture of $f/2$. In addition, each projector is equipped with a sliding device for inserting the Hypergonar lens. Each projector is also equipped with a Hall & Connolly high-intensity lamp. The current in each arc lamp is 250 amperes at 70 volts.

As this projection is in a class by itself and requires perfectly homogeneous luminous zones, it was necessary to use extra-luminous Bausch & Lomb condensers to concentrate the light of the arc upon the picture gate. The arcs are fed by a special 800-amp. 110-v. generator, and 16-mm. positive and 11-mm. copper-coated negative carbons are used.

To photograph the scenes two cameras are necessary, each taking simultaneously one-half of the picture. Each camera is equipped with a Hypergonar lens. Each half-image is projected simultaneously by the two outside projectors, the right-hand projector projecting the image on the left-half of the screen, and *vice versa*. The junction of the two images is smoothed out by special masks consisting of two stationary shutters, the edges of which are cut like the teeth of a saw and set into the light-beams where the latter superimpose. Each of these stationary shutters was set about one meter in front of each projector, on the left and right, outside the beams. The shutters could be adjusted by means of a micrometer screw, thus concealing almost entirely the junction of the two images.

Standard film can be projected by the central projector, the outside projectors merely running idle. The projected image in such case measures 14 x 10 meters, the brightness being about the same as in the case of panoramic projection. The distance between the projectors and the screen was approximately 60 meters. Projection occurred daily from 9:30 A.M. to midnight, and the apparatus operated quite satisfactorily.

Film-Weld, Tested Exhaustively, Wins I. P. Endorsement

Exhaustive tests of Film-Weld, new film binding agent, made at the request of the distributor, have just been concluded by I. P. These tests indicate that this product is really unique and fully substantiate the claims made for it. Among the conclusions reached were:

1. Film-Weld is totally unlike film cement—it is as clear as water and flows as freely.

2. Its rate of evaporation is very slow.

3. It will not thicken or harden, nor does it ever require any thinner. Samples left exposed to the air until almost completely evaporated exhibited the same binding strength as when the container was first opened.

4. It made a very secure patch, even by hand, that exhibited greater binding qualities than samples of film cement tested at the same time.

5. Because of its nature, it made a thinner join than samples of film cement tested.

6. It is equally efficient on both nitrate and acetate film, whether in black-and-white or in color.

Film-Weld is the product of a mid-Western university laboratory, and it has long been used in the plastics field. Discovered by a film laboratory technician, its application to the motion picture field followed speedily. It is distributed exclusively by Larry Strong, Inc., 1241 So. Wabash Avenue, Chicago, Ill., who reports that Film-Weld has already been adopted as standard by numerous theatre circuits, including Balaban & Katz; by laboratories, exchanges and studios. Prices compare favorably with film cement.

I. P. considers Film-Weld a highly efficient and economical aid to better projection and recommends it unqualifiedly.

Fundamentals of Mathematics

By *GEORGE LOGAN*

SOUND DEPARTMENT, METRO-GOLDWYN-MAYER STUDIOS

II. Positive and Negative Numbers; Addition, Subtraction, Multiplication, and Division of Monomials.

It will be a help if the reader digest each article as it appears, for the ideas presented in subsequent sections hinge upon an understanding of topics discussed in earlier sections. Further, it is desirable that the issues of this series be cached away after reading, as back-reference may be useful before the series is completed.

The various examples given throughout the series will be best understood if the reader will work them out on paper, duplicating, step-by-step, the solutions given in the text.

BEFORE we wade right into our discussion of positive and negative numbers, a good general idea to keep in mind is: if a quantity is under consideration, and another quantity *increases* the quantity under consideration, the second quantity is *positive.*

If a quantity is under consideration, and another quantity *decreases* the quantity under consideration, the second quantity is *negative.*

Certain things should be said about the physical meaning of positive and negative numbers. Now, insofar as positive numbers are concerned, most every material thing or phenomena within our conception can be counted, measured, weighed, timed, or otherwise evaluated by the system of positive numbers. But this universality of application is not true of negative numbers. You cannot have a negative number of sheep, for example. Nor can you have a negative population, a negative weight for a piece of iron, or a negative number of boats. You either have a positive number denoting the magnitude of such physical things, or you have none at all —that is, zero.

On the other hand, there are instances wherein negative numbers can be and are used to manifest a state of magnitude. Perhaps you have driven through regions which are below sea level (we have 'em in California) and you have noted sign posts which read: Elevation —20. The meaning is simply that that particular locality is twenty feet below the arbitrary reference level—sea level. And, too, one frequently sees sub-zero temperatures referred to as —5°, —10°, —15°, and so on. There again we have a practical application of and a physical meaning for negative numbers.

So, we repeat, negative numbers may or may not have a rational meaning, dependent entirely upon the nature of the quantity to which they are applied. Thus a negative number of pencils is a false concept, but a negative temperature is understandable, for it simply implies a specified number of temperature units below an arbitrary reference temperature. On the Centigrade scale, this reference temperature is understood to be the temperature at which water freezes, 0° Centigrade.

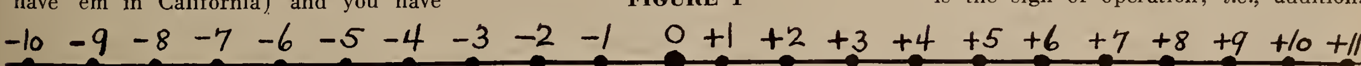
From the foregoing it may be stated that:

1. Negative numbers have a rational meaning only when they pertain to particular phenomena or physical magnitudes.

2. When negative numbers do have rational meaning, they co-exist with a particular reference or datum point on the measurement scale in which they are used.

To further illustrate our point, it would be possible to revise our method of denoting years in history. Now we write 50 B.C., or 1939 A.D. The reference point in this system is, of course, the time of the birth of Christ. Keeping the same reference point we could justifiably write —50 and +1939. Under such a revised system, mention of the year —50 would be easily recognized as 50 years before our reference time; and mention of the year +1939 would mean nineteen hundred and thirty-nine years after our reference time.

FIGURE 1



The conventional way of providing a visual idea of the relation between positive and negative numbers is by diagram such as is shown in Fig. 1. The positive series of numbers start at zero and advance toward the right. The negative series of numbers start at zero and advance toward the left. The point 0, then, corresponds to the reference point we have described.

The number *negative three* or *minus three* is written —3. The number *positive five* or *plus five* is written +5. Often the + sign is omitted before positive numbers, but in such cases its presence is understood. But the negative sign, —, is never omitted before a negative number.

In arithmetic we have become accustomed to thinking of the signs + and — as signs of operation, that is, + means addition, and — means subtraction. They are also used to denote the same operations in algebra. But when we enter the algebra field these signs take on another significance. That is, + and — continue to be used to indicate addition and subtraction in algebra, but these signs are also used to signify the *nature* of the quantity under consideration, whether positive or negative.

For this reason algebraic numbers are often enclosed in parentheses to enable us to readily distinguish between the *nature* of the numbers and the operations to be performed on the numbers. After dexterity has been acquired in the handling of positive and negative numbers the parentheses may be omitted in many cases, but until that skill is attained the use of parentheses is recommended.

Let's try some specific examples in addition. Add *positive* seven and *positive* two. This is written:

$$(+7)+(+2)=+9$$

The + sign between the parentheses is the sign of operation; *i.e.*, addition. The + signs before the numbers themselves are signs showing the nature of the numbers; *i.e.*, both numbers are positive.

This operation for addition may be illustrated by reference to Fig. 1. Begin at the point on the scale occupied

by the first number $(+7)$, and move $(+2)$ units from that point. This brings us to $+9$.

Here's another: Add *positive* seven and *negative* two. This is written:

$$(+7)+(-2)=+5$$

Whereas before we started at $(+7)$ on the scale and moved to the right, because $(+2)$ was to be added to $(+7)$, now we start at $(+7)$ and move two units to the left, because (-2) is to be added to $(+7)$. This brings us, of course, to the point $+5$.

And yet another illustration: Add *negative* seven and *positive* two. This is written:

$$(-7)+(+2)=-5$$

Here below are some more examples which will serve for practice. Each problem is written twice—once in the left-hand column, once in the right-hand column. The rigorous form of writing the problem is used in the left-hand column; that is, parentheses are used freely to help differentiate between the *nature* of the numbers and the *operation* to be performed upon the numbers. But, as has been stated, when a number is positive the + sign before it may be omitted as long as its presence is understood. Hence in the right-hand column we have written the problems with permissible eliminations of some + signs and parentheses.

$(+2)+(+3)=+5$	$2+3=5$
$(+4)+(-2)=+2$	$4+(-2)=2$
$(-3)+(+3)=0$	$-3+3=0$
$(-6)+(-6)=-12$	$-6+(-6)=-12$
$(-7)+(+1)=-6$	$-7+1=-6$
$(+5)+(-6)=-1$	$5+(-6)=-1$

These sums we have been finding are known as *algebraic* sums, for the *signs* of the numbers involved must be considered as well as the *magnitudes* of the numbers. When sums are found in simple arithmetic—arithmetical sums—all of the numbers involved are always positive. But when algebraic sums of numbers are to be found these rules must be kept in mind:

If the numbers have the same signs, determine the sum of their numerical values, and place the common sign before the result.

If the numbers have different signs, find the difference between their numerical values, and place the sign of the larger number before the result.

If, for example, more than two algebraic numbers are to be added, combine all the positive numbers to form one number, combine all the negative numbers to form one number, and with the two numbers thus obtained proceed by the rules above.

$$\begin{aligned}(+4)+(-3)+(+7)+(-6)&=\\ &[(+4)+(+7)]+[(-3)+(-6)]\\ &(+11)+(-9)\\ &+2\end{aligned}$$

An algebraic quantity formed by prefixing a coefficient to a letter or letters is known as a *monomial*. Thus $7a$, $2b$, $4a^2k$, etc., are monomials. If the symbols following the coefficient are in each instance the same, we have what are known as similar monomials. Thus $6yb$, $4yb$, $-7yb$, $2yb$, are similar monomials.

When adding a group of similar monomials find the algebraic sum of the coefficients, and prefix this sum to the common letters. As an example:

$$\begin{aligned}(+4kn)+(-3kn)+(+7kn)&=\\ &[4+7+(-3)]kn\\ &[11+(-3)]kn\\ &8kn\end{aligned}$$

Often the simpler problems of finding the sum of a group of similar monomials can be performed mentally. Thus, in the first example given below, the sum of the positive coefficient is $+12$, sum of the negative coefficients is -7, so the net sum of the coefficients is $+5$.

6s	8tm	$-6v^2$	$3x^3y$
6s	7tm	$+3v^2$	$-1x^3y$
-4s	-6tm	$+2v^2$	$-4x^3y$
-3s	-4tm	$-4v^2$	$+9x^3y$
5s	5tm	$-5v^2$	$7x^3y$

Now that we have laid the foundation for addition of algebraic quantities let us next consider subtraction of algebraic quantities. Here's the rule to remember:

If any number b is to be subtracted from any number a, change the sign of b and add b to a. Showing application of this rule:

$$(+a)-(+b)=(+a)+(-b)$$
$$(+a)-(-b)=(+a)+(+b)$$
$$(-a)-(+b)=(-a)+(-b)$$
$$(-a)-(-b)=(-a)+(+b)$$

Hence the sign indicating the operation of subtraction, $-$, is changed to the sign indicating the operation of addition, $+$, when the rule for subtracting is complied with. Let us say that $b=4$ and $a=6$, and solve the above four examples with the substitution therein of those values.

$$(+6)-(+4)=6+(-4)=2$$
$$(+6)-(-4)=6+4=10$$
$$(-6)-(+4)=-6+(-4)=-10$$
$$(-6)-(-4)=-6+4=-2$$

Usually simple algebraic subtraction can be performed mentally saving the time required to write the process down in detail as we have done above. In the following examples the lower member is to be subtracted from the upper member. Remember the rule and try them.

19	42	-12	16	17	-15
-6	40	9	-3	8	10
25	2	-21	19	9	-25

Subtraction of monomials is an easy step forward. *Change the sign of the coefficient of the monomial which is to be subtracted, and add that coefficient to the coefficient of the similar monomial; and then annex the common letters to the result.*

In the following examples illustrating application of this rule the lower monomial is to be subtracted from the similar upper monomial. Hence, in the operation, change the sign of the coefficient of the lower monomial and add that coefficient to the coefficient of the upper monomial.

19xy	$4c^2$	-15sk	3r	$12n^3ab$
17xy	$-2c^2$	1sk	3r	$-7n^3ab$
2xy	$6c^2$	-16sk	0	$19n^3ab$

We move along to a discussion of multiplication of algebraic numbers. The primary thing to remember here is: *When two numbers of the same sign are multiplied, the product is positive. When two numbers of opposite sign are multiplied, the product is negative.* Thus:

$$(+m)\times(+n)=+mn$$
$$(+m)\times(-n)=-mn$$
$$(-m)\times(+n)=-mn$$
$$(-m)\times(-n)=+mn$$

If we substitute 2 for m, and 3 for n:

$$(+2)\times(+3)=+6$$
$$(+2)\times(-3)=-6$$
$$(-2)\times(+3)=-6$$
$$(-2)\times(-3)=+6$$

It is suggested that the reader work out the following problems independ-

ently. Place a card over the results, and when you have your own answers compare them with those given.

$$-4 \times 6 = -24$$
$$9 \times -t = -9t$$
$$-8 \times -8 = +64$$
$$-k \times -g = +kg$$
$$14 \times -s = -14s$$
$$-a^2 \times -b^2 = +a^2b^2$$

Before we proceed much further discussing multiplication it is necessary to find out what happens when a given number raised to a power is multiplied by the same number raised to a power. In other words, what is the result when we have:

$$a^2 \times a^4$$

This we know:

$$a^1 = a$$
$$a^2 = aa$$
$$a^3 = aaa$$
$$a^4 = aaaa$$

Hence:

$$a^2 \times a^3 = aa \times aaa$$
$$= aaaaa$$
$$= a^5$$
$$= a^{2+3}$$

Similarly:

$$a^3 \times a^3 = aaa \times aaa$$
$$= aaaaaa$$
$$= a^6$$
$$= a^{3+3}$$

The foregoing analysis brings out the general rule for writing the product of several identical numbers, each of which is raised to a power. *The product is the number with an exponent equal to the sum of the exponents.*

Suppose we are to find the product of the monomials $3r^2y$ *and* $2ry^2$.

$$3r^2y \times 2ry^2 =$$
$$3 \times r^2 \times y \times 2 \times r \times y^2$$

We can rearrange the order of the factors without changing the value of the product. Thus:

$$3r^2y \times 2ry^2 =$$
$$3 \times 2 \times r^2 \times r \times y \times y^2$$
$$6 \times r^{2+1} \times y^{2+1}$$
$$6r^3y^3$$

Find the product of $2n^3t^2$ *and* $-4nt$:

$$2n^3t^2 \times -4nt =$$
$$2 \times n^3 \times t^2 \times -4 \times n \times t$$
$$2 \times -4 \times n^3 \times n \times t^2 \times t$$
$$-8 \times n^{3+1} \times t^{2+1}$$
$$-8n^4t^3$$

Below are some more examples to try. Check your results against those given.

$6k^2$	$3pr$	$-9svw$
$2k$	$-2p^2r^2$	$2sv$
$12k^3$	$-6p^3r^3$	$-18s^2v^2w$

Our final topic in this second section is division of algebraic quantities. The important thing to keep in mind is: *If the dividend and the divisor have the same sign, the quotient is positive. If the dividend and divisor have opposite signs, the quotient is negative.*

$$\frac{+8}{+4} = +2 \qquad \frac{+8}{-4} = -2$$

$$\frac{-8}{-4} = +2 \qquad \frac{-8}{+4} = -2$$

At this point it is necessary to investigate what happens when a given number raised to a power is divided by the same number raised to a power. In other words, what is the result when we have: $\frac{a^4}{a^2}$

We know that $a^4 = aaaa$. We know that $a^2 = aa$. Hence, by cancellation of identical factors above and below the division line:

$$\frac{a^4}{a^2} = \frac{aaaa}{aa}$$
$$= aa$$
$$= a^2$$
$$= a^{4-2}$$

Similarly:

$$\frac{a^5}{a^3} = \frac{aaaaa}{aaa}$$
$$= aa$$
$$= a^2$$
$$= a^{5-3}$$

$$\frac{a^3}{a^1} = \frac{aaa}{a}$$
$$= aa$$
$$= a^2$$
$$= a^{3-1}$$

Hence, in general:

$$\frac{a^m}{a^n} = a^{m-n}$$

The foregoing analysis above brings out the rule for writing the quotient when the dividend and the divor are the same number, and the dividend and the divisor are each raised to a power. *The quotient is the number with an exponent equal to the divisor's exponent subtracted from the dividend's exponent.*

With this rule in mind we can progress to division of similar monomials.

$$\frac{4a^6}{2a^2} = 2a^{6-2}$$
$$= 2a^4$$

$$\frac{16a^3b^2}{2ab} = 8a^{3-1}b^{2-1}$$
$$= 8a^2b$$

$$\frac{-14x^3y^9}{2x^2y^7} = -7x^{3-2}y^{9-7}$$
$$= -7xy^2$$

Relax—that's all for this section.

(TO BE CONTINUED)

'Color Correction' Defined

There exists the widespread impression that "color correction" refers to some mysterious adjustment or property of a lens which causes it to photograph different colors in their exact shades or intensities. This is not true. Faithful reproduction of natural color on color film is a function of the film itself, not of the lens. Any lens will photograph blue as blue, red as red, within the limitations of the film and of the exposure; but *not* every lens will photograph objects of all different colors with equally sharp, crisp detail.

It is an optical law that different colors in a given scene will focus on different planes if the lens is not designed to correct for this principle. For example, with an inferior lens in the camera, everything that is red in a scene might photograph sharply and in great detail, while all yellow and green objects would be fuzzy or unsharp on the screen. But the lens that *is* color corrected with photograph objects of *all* colors with maximum sharpness, for it is designed to focus all colors as nearly as possible on the same plane.

● Sharp Definition Paramount

Color correction, then, is entirely a matter of sharp definition, all over the picture, and it is obvious that to say that a lens "will photograph color" means nothing at all. To know definitely that a lens is highly color corrected is to be sure of the finest in color movies.

Of importance is the fact that color corrected lenses are just as important for black-and-white movies as for color film. Even though black and white film records various colors in different shades of gray, if those colors do not focus sharply on the film, their gray images cannot be sharp. That is why lenses were color corrected long before the advent of natural color film.
—*Bell & Howell Co.*

RCA-NATIONAL THEATRES DEAL

RCA has renewed the contract to service the sound reproducing equipment in the more than three hundred houses operated by National Theatres Amusement Co. Original deal was signed in 1936. Theatres covered by the service contract include those of the Fox West Coast, Evergreen Theatres, Fox Wisconsin Theatres, and Fox Intermountain Theatres circuits.

GIESSEMAN TO ALTEC

Clifford E. Giesseman, formerly general manager of United Detroit (Trendle) Theatres, has been appointed Altec sales representative in the Middle West, with headquarters at Detroit.

Process Projection Specifications

A REPORT BY THE RESEARCH COUNCIL, ACADEMY OF M. P. ARTS & SCIENCES

PART V. THE OPTICAL SYSTEM

SPEED (Basic):

The optical system shall have a speed of F2.0 or greater.

(Auxiliary): The foregoing recommendation should not be construed to mean that developments beyond a speed of F2.0 are not anticipated. On the contrary, an F1.6 system is to be expected in the future.

ADJUSTMENT (Basic):

Adequate lateral, vertical and longitudinal adjustment facilities shall be provided for all units of the optical system, irrespective of the projection lens.

COLOR BALANCE (Basic):

The optical system shall contribute no noticeable color, and that same order of spectral uniformity should extend to a wave-length of 3800 A°.

COLOR BALANCE (MIRROR SYSTEM) (Basic):

All mirrors used in the mirror-type optical system shall be surfaced with aluminum, or at least its equivalent.

Primary Condenser

FOCAL LENGTH (Basic):

The primary condenser shall be of a focal length to give a maximum amount of light output using an F2.0 system. (See "Speed, Auxiliary").

PROTECTIVE DEVICES (Basic):

The condenser mounting shall be so designed as to give sufficient clearance within the lamphouse to allow for expansion of the condenser due to increase in temperature during operation. Protective devices should also be provided to eliminate destructive air currents from the condenser when the lamphouse door is open. (See "Ventilation of the Lamphouse").

(Auxiliary): An attempt should be made to design a method whereby the lamp could be retrimmed without subjecting the condenser to drafts or sudden temperature changes. (See "Ventilation of the Lamphouse").

CONSTRUCTION (Auxiliary):

The element of the condenser nearest the crater should be designed and constructed somewhat thicker than at present so that pitting of this condenser can be removed by regrinding and polishing as required.*

Condenser Relay Type System

FOCAL LENGTH (Basic):

The relay condenser type system shall be designed to permit as short a set-up as possible and still deliver the maximum amount of light with an F2.0 beam or cone of light. (See "Speed, Auxiliary").

ADJUSTMENT (Basic):

The condenser relay mount shall be so designed as to permit both horizontal and vertical adjustments in both directions with a suitable pitch thread, so constructed as to maintain their setting.

PROTECTIVE DEVICES (Basic):

The mountings of the condenser system shall be designed to give sufficient clearance to allow for expansion of the condenser during temperature rises.

Lenses

APERTURE (Basic):

A lens shall be provided with an aperture of F2.0 or greater. The screen brightness should be controlled by a diaphragm in the case of an excess quantity of light, provided such a design could be made practical.* (See "Speed, Auxiliary").

COLOR CORRECTION (Basic):

The lens shall be panchromatically corrected to conform as nearly as possible to the correction of the best camera lenses; that is, the lens should be corrected not only visually but photographically. The secondary spectrum should be as flat as possible.

DISTORTION (Basic):

The distortion shall be less than six parts in a thousand.

(Auxliary): It has been suggested that the foregoing basic recommendation on distortion be reduced if possible. However, this should not be done at the expense of other types of lens correction.

DEFINITION, RESOLVING POWER, COVERAGE, AND FLATNESS OF FIELD (Basic):

The definition, resolving power, coverage, and flatness of field shall be comparable, as nearly as possible, to good anastigmatic photograhic lenses.

CONSTRUCTION (Basic):

The lens shall be accurately constructed so as to be centered both optically and mechanically.

STANDARDS OF LENS MOUNT DIAMETERS (Basic):

The Committee recommends that the following be adopted as standard for lens mount diameters and submitted to the American Standards Association for consideration for formal standardization:

1. Lenses of F2.0 and F1.9 focal ratios are of particular interest to the industry at the present time. Everything possible should be done to produce lenses of these speeds whose performance is satisfactory for background projection. All possible development should be made on F1.6 projection lenses from 4" to 6" focal lengths. There will be a demand for this series when it is produced with sufficient correction to permit its use in background projection work.
2. Studios will use F2.0 and F1.9 lenses up to and including 4" focal length with the diameters that are adopted by the manufacturers as standard for theatre use. It is strongly urged, however, that the diameters of the F2.0 and F1.9 lenses be kept as consistent as possible and with as few changes in shell diameter throughout the series as is practical. The latter restriction applies also to any F1.6 lenses and may be developed.
3. For lenses of longer focal lengths, the standard lengths shall be 5", 6", 7", and 8". All other focal lengths will be in the nature of special requirements, to be supplied upon individual studio order.
4. Lenses of the F2.0, F1.9, or F1.6 series with focal lengths of 5", 6", 7", and 8" will maintain an outside barrel diameter of 4½".
5. Lenses of an F1.6 speed will be in focal lengths of 4" to 6" inclusive. Lenses with focal lengths longer than 6" should maintain a constant lens diameter up to

(*Continued on page* 26)

*Note: It has been suggested that the use of an auxiliary thin quartz plate between the arc and the preliminary element of the condenser might furnish a protection for this condenser element, provided too great a light loss is not introduced.

*Note: The relay condenser system, because it does not focus the crater of the arc on the aperture, gives a smoother illumination. Furthermore, this system is not limited by as many uncontrollable items as is the mirror system, such as the increase of heat, increase of size of lamphouse, etc., associated with increased speed of the mirror.

Experiments have proven that it is possible to diaphragm certain types of projection lenses used in process work without having the diaphragm actually in the lens.

This diaphragm is located just in front of the front element. Tests with Bausch and Super-Cinephor lenses show that perfectly uniform light control is obtained with no trace of increase of existing vignetting or hotspot due to stopping down of the diaphragm at this position. The definition of the image improves greatly when the iris is stopped down. Further tests with other types of lenses must be made to be certain that this method can be applied to all types.

Classifications in Report

In order to clearly specify the relative importance of the various recommendations included in the report, each subheading in each part is indicated by one of the three following classifications:

BASIC—Recommendations so indicated incorporate definite requirements and principles. (Printed in bold face type.)

AUXILIARY — Recommendations so indicated are suggested methods of meeting basic requirements. (Printed in light face type.)

ACCESSORY—Indicates optional special refinements which add to the ease of operation of equipment. (Printed in italic type.)

Defining Light-Sensitive Cells

By *SAMUEL WEIN*

The author of the appended article is a noted worker in the electronic field, particularly in that branch relating to light-sensitive devices, several novel types of which are the result of his efforts. His many contributions to the art are recognized throughout the world, the technical literature being replete with references thereto.

ALMOST everyone has heard of the photo-electric cell ("electric eye"). Hardly a day passes that we don't read in the newspapers or trade journals of some interesting or unique application to which the "eye" has been put. This article discusses the various types of light-sensitive cells commonly referred to in the literature.

There are available today four distinct types of devices commonly termed "photo-cells," each of which differs in its functional characteristics as well as in its general physical construction. Before discussing these in detail, we might consider what is a "cell," that is, what it is supposed to be and do.

The expression "photo-cells" denotes any device which will react electrically to light. This term is too broad, since it entails the different types of cells, not all of which are true "photo-cells" in the sense of correct technical definition, even though all are classified as light-sensitive cells.

If the term "light-sensitive cell" were applied to all the four different types of cells as one device or product, it would be a more fitting name. Simply expressed, the term "light-sensitive cell" denotes, as already stated, a device which will react to light; whereas the term "photo-cell" relates to one specific type or form of light-sensitive cell.

The expression "light-sensitive cell" is a bit cumbersome, and the industry has been seeking for an expression that will be readily recognized not only by technicians but even by the "man in the street". To this end the expression "electric eye" has been popularly accepted as denoting any type of device that is light-sensitive.

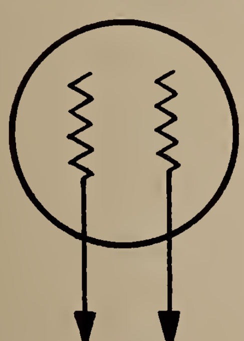


FIGURE 1

Let us consider the derivation of the name "photo-cell." The word *photo* is derived from the Greek, and is known as *phot* or *phos,* meaning light, or "*phao*", to shine. From this we derive phosphor, a chemical element that shines, and phosphorescence, meaning to give forth light.

In the case of the word "cell," we find that it is derived from the Latin *cella,* meaning a small room or chamber. Speaking in terms of electricity, it is understood to denote a device which contains two electrodes inserted in an electrolyte, generating a source of current (E. M. F.), a battery. The true meaning of the word "battery," as generally understood, is where two or more cells are electrically connected in a circuit so that it will increase either the current or the voltage output, depending on how they are connected.

Now that we have a better understanding of the nomenclature used, we are better able to consider the different types of cells available.

● Photo-Conduction Cells

In the technical literature the use of such terms as "bridge," "unit," "element," or "resistor" designates the device we recognize as a photo-conduction cell. The term "cell" in the present case is a misnomer, but since that name is universally employed we are compelled to use it in order to avoid further discussion of terminology. The reason that the term "cell" is incorrectly applied here is because the device does not generate a potential upon exposure to light.

The photo-conduction cell consists of a metallic element or a compound of elements which when exposed to light will exhibit a change in its electrical resistance (Ohmic value) when connected in series with a source of current and an indicating meter. It is commonly known as a photo-resistance type of cell.

There are two distinct types of construction: (1) the winding of two wires around an insulating medium, with the element, usually selenium, being spread between the wires and annealed in order to render it light-sensitive, and (2) a glass plate on which has been deposited either gold, platinum or silver, which is divided into two electrical portions by means of a sharp tool, with the selenium being deposited over the entire surface and properly annealed. Although no symbol has as yet been assigned to it, Fig. 1 is offered as typical of this device.

● Photo-Voltaic Cells

The terms "Becquerel effect" and "photo-voltaic cell" are used to distinguish other forms of light-sensitive cells. Expressed simply, the photo-voltaic cell consists of two metals inserted in an electrolyte (solution), and by exposing one of these electrodes to a source of light a potential is generated. By way of illustration, it might be said that we have here in the most elemental form a light-sensitive battery, a chemical change taking place on the surface of the exposed electrode.

The name Becquerel is very well known to scientific investigators since it was he who first observed the radio-active emanations of carnotite or pitchblend which later proved to be radium. This investigator also discovered the electrical effect obtained by exposing the metal plates in an electrolyte, thus the term "Becquerel effect". The effect is also commonly known as the "photo-voltaic effect". The Becquerel effect was first observed as early as 1839.

There are at the present time two known forms of photo-voltaic cells: (1) those in which the electrodes themselves are light-sensitive, and (2) those in which the electrolyte and not the electrodes are light-sensitive. Only the former types are available on the open

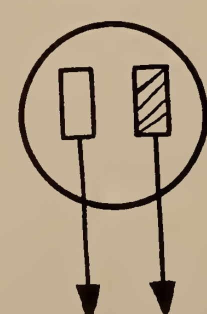


FIGURE 2

market; the second type still is in the experimental stage of development.

No accepted symbol has been assigned to this type of cell. In Germany and in England Fig. 2 has been used to some extent as a symbol. Here the active metal electrode forms the positive pole of the cell.

● Barrier Type Cell

The modern "barrier" cell is accredited to the efforts of C. E. Fritts who in 1881 deposited on an iron disc a film of selenium, and on this latter a translucent film of gold.

At the present time there are two types of barrier cells available, differing only as to the choice of base metal used and the active or sensitive film. These two types are (1) that in which a film of selenium is deposited on an iron disc and properly annealed in order to render it light-sensitive, and (2) that in which a film of cuprous oxide is formed on a copper disc at elevated temperature, with, of course, subsequent chemical treatment in order to dispose of the cupric oxide which is found to be deleterious. There is then deposited on top of the selenium or cuprous oxide film a translucent conductor (electrical), so that contact might be taken off the back side of the base metal (iron or copper).

The complete circuit then is effected by taking contact off the translucent conductor. The light-sensitive material (selenium or cuprous oxide) is sandwiched in between the base metal and the translucent conductor. In the place of gold other metals may be used as the translucent conductor, for instance, silver, platinum, cadmium, *etc.*

While the effect has been commonly known for more than fifty years, it has only recently been accepted in the commercial field and in the academic laboratories as an instrument. No

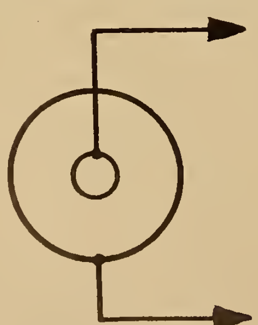


FIGURE 3-A

scientific organization has formulated standards for these types of cells.

In the United States no accepted symbol for recognizing the cell in a circuit has been designated. In Germany the symbol as seen in Fig. 3-A has been used in the technical literature to a great extent, and since it does not appear to have similarity to other types of cell symbols, it might conveniently be used. In England and in the United States Fig. 3-B has been used to some extent, and in the United States Fig. 3-C has been used to a great extent.

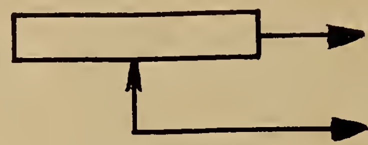


FIGURE 3-B

Other names assigned to this type of cell are (a) Sperrschicht (b) self-generating (c) barrier plane (d) photo-voltaic (dry type); (e) blocking layer, and (f) dry disc photo-electric.

● Photo-Electric Cell

The term "photo-electricity" in its broadest sense refers to "any electrical effect resulting from light." This is a very wide term and properly should only be used when and if applied to all forms of light-sensitive cells, and not to specific type or form. However, we are concerned in the present discussion with that type of light-sensitive cell which corresponds to the "Hallwach effect," that phenomenon in which electrons are driven off a given surface upon exposure to light.

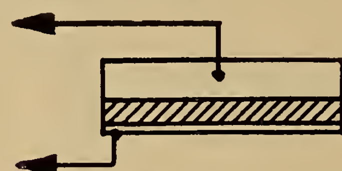


FIGURE 3-C

In 1888, Hallwach demonstrated that a negatively-charged body loses that charge when ultra-violet light falls upon its surface; but when positively charged, the body is not influenced by light. The earliest form of photo-cell usually consisted of a zinc plate freshly cleaned with sandpaper, *etc.*, which acted as one electrode, and in front of it was placed a collector, acting as the second electrode. The intervening space was, of course, filled with air at atmospheric pressure. The results thus obtained were poor, but it was demonstrated to the physicists at that time that light caused the flow of "particles" between the zinc plate and the collector.

Elster and Geitel took up the work of Hallwach, testing a great number of the metallic elements. They soon discovered that "alkali metals," when freshly distilled into evacuated glass bulbs, would give rise to a much more sensitive cell than that previously described. Following that discovery, it was soon established that if these metals were treated by a brush discharge (electrical) in the presence of hydrogen, the alkali metal would become colored and simultaneously increase its sensitivity to light manifold. This was known as the "hydride" cell. A further development was an increase in its sensitivity by admitting a trace of a noble gas such as neon, argon, helium, *etc.*

The next development concerns the reaction between the alkali metal (caesium) and oxygen, forming the corresponding caesium oxide. In this case the cell is formed by distilling caesium on metallic silver (plate), and oxidizing both the silver and the caesium to form the corresponding silver-caesium oxide, the modern form of photo-cell. To further increase its sensitivity, the cell has a trace of one or more of the noble gases.

The photo-electric cell is the only type of light-sensitive cell that has an accepted symbol assigned to it. This is shown in Fig. 4, and is the work of the I.R.E. Standardization Committee.

St. Louis L. 143 Election; High Court Appeals Set

Officers named for St. Louis projectionist Local 143 in an election ordered by the Circuit Court following decision which abrogated I. A. control of the union are as follows: Robert Tomsen, pres.; William Robinson, v.-p.; O. R. Myers, sec.-treas.; E. D. James, rec.-sec.; Julian Anthony, sgt. at arms; trustees: George Hess, L. C. Chambers and Homer Tong.

Election precipitates novel situation in which duly elected officers of a labor union will serve under the supervision of a receiver, recently appointed, whose tenure of office was not affected by the election.

Scheduled for hearing before Missouri Supreme Court at its Sept. term is appeal of John P. Nick, I. A. v. p., and Clyde Weston, former b. a. of L. U. 143, from decision of lower court appointing a receiver for union. Similar hearing set for case of William F. Canavan and other intervenors, who sought to have lower court accept an appeal bond which would have automatically voided the receivership.

The Baird Theatre Television Receiver

By *MATT RAYMOND, JR.*

BAIRD TELEVISION, LIMITED

The appended article is an excerpt from a lecture delivered recently before the London Court of the Guild of British Kinema Projectionists and Technicians, through the courtesy of which it is reproduced here. The excerpt, while extremely general in nature, will serve to convey to projectionists some idea of the Baird theatre system, pending the publication in I. P. of a promised detailed exposition of the topic by Baird engineers now actively engaged in demonstration work in New York City.—*Editor.*

AS IN the early days of sound pictures, a survey of the theatre will have to be taken. It will be necessary in order to determine the best position for the aerial to take field strength measurements and advise the best location for the equipment in the theatre.

The radio signal sent out by the transmitter is picked up by an ultra short-wave receiving aerial of special design. It is necessary to have this erected as high as possible above the building and pointing towards the station radiating the signal. In addition, and in order to overcome any chance of automobile ignition interference, it is strongly advised to have the aerial as far away from the road as possible. The signal received by the aerial is delivered to the theatre receiver through a low-impedance lead-in feeder cable.

All-Electric, No Moving Parts

The equipment is all electric, having no moving parts whatsoever, thus eliminating mechanical breakdown risks, and is foolproof, compact and exceedingly simple to operate. It is comprised of two main units: projector unit, and extra high tension rectifier unit.

The projector unit is composed of two complete receivers and houses two projection tubes, each having its own separate time base generator and scanning equipment, vision receiver and amplifier, sound receiver and power supplies. When receiving a program both tubes are run simultaneously, only one tube actually projecting on to the screen. It is thus possible to fade over from one tube to the other if necessary.

The unit is placed in the auditorium and projects the picture directly on to the viewing screen. A special screen is employed and is placed in front of the normal theatre screen. The projector is usually placed about 30 feet from the viewing screen.

A special projection tube has been developed by Baird having a very high vacuum and producing an extremely bright picture on its fluorescent screen. It is this picture which is projected on to the viewing screen via a lens.

The Projection Tube

The construction and functioning of the tube is very similar to the ordinary radio valve. The electrode assembly of the tube is carried by a glass pinch and consists of a filament which is the source of electron supply; a cylindrical electrode called the modulator, which has a similar function to the control grid of a valve and to which the vision signal is fed, the signal having been amplified; and an anode or accelerator to which the electrons are attracted.

In order that the electrons can reach the fluorescent screen, the anode is provided with a hole through which they can pass. The purpose of the electrodes so far described is to provide a beam of electrons and to give these sufficient velocity so that they will strike the screen of the tube where their presence is made visible by causing the specially coated surface to fluoresce.

The modulator, which is similar in action to the grid of a valve, varies the density of the electron stream so that the amount of light caused by their impact on the screen will act accordingly. The beam is made to swing from side to side and downwards line by line by applying suitable magnetic fields which are created by placing coils round the neck of the tube which houses the electrode assembly.

These coils are fed with electric impulses generated by the scanning circuits or time base generators. These impulses are synchronized with the pulses sent out by the transmitter and so cause the electron beam to travel across the screen in synchronism with the beam in the camera. Thus the picture produced on the screen will be an exact reproduction of the image projected upon the mosaic of the camera.

Special E.H.T. Unit

In order to ensure an adequate source of high voltage for the anode of the projection tube, a special high tension rectifier unit has been developed. This consists of a voltage doubling circuit, using two tubes, and is capable of giving an output of 60 K.V. at 10 ma. The normal working voltage of the tube is 36,000 volts, 300 microamps.

The tubes are mounted above the unit, each being supported by insulators, which are removable for transport purposes. Separate transformers are arranged to heat each of the filaments. Both these and the main e.h.t. transformer, as well as all smoothing arrangements, *etc.*, are immersed in one common tank filled with insulating oil. A safety or ballasting resistance is connected across the output supply of the e.h.t. transformer in order to protect the winding, should a short-circuit occur. The output is then fed via a control to the anode of the projection tube.

The e.h.t. unit is housed in a safety cage, so that when the door of the cage is open the supply is automatically switched off, and the positive terminal grounded. Similarly, it is not possible to restart the equipment unless the door is correctly shut. The whole equipment is exceedingly economical to run, the total consumption being 2 k.w. which is equal to the current consumption of the average electric fire. It is designed to work off a.c. 50-cycle mains, 200-250 volts.

The equipment described is similar to that installed in various London theatres and is capable of producing a picture 15 ft. x 12 ft. in size, with a degree of brilliance which precludes any possibility of eyestrain[1].

Regarding the sound installation, two loudspeakers, each with its own amplifier, are provided which are capable of delivering 15 watts undistorted signal to each speech coil, the signal being provided by the radio receiver contained in the projector unit.

[1]NOTE: Projectionists may regard this as a phenominal achievement for the baby art of television, beset as it is with many and varied problems of illumination, in view of the fact that comparatively few motion picture theatres, including some in the de luxe class, have yet to attain this goal.—Ed.

Excuse It, Mr. Barrows

In reporting recently the election of P. A. McGuire and James J. Finn as honorary members of the Guild of British Kinema Projectionists and Technicians, I. P. stated that they were the only American members. Stanley T. Perry, Guild prexy, informs us with bated breath that we err grieveously: five years ago the estimable Thad Barrows, president of Boston Local 182, while in London was tendered honorary membership in the Guild. This circumstance definitely relegates Messrs. McGuire and Finn to kindergarten.

GoldE Oil-Drive Takeup

A new oil-driven takeup has just been introduced by the GoldE Mfg. Co. Accurately machined, the takeup is a totally enclosed device filled with a special oil and permanently sealed. Not only will the viscosity of the oil not change, but the takeup will suffer none of the effects of dust, dirt, oil, lint, etc.

When sealed this new oil-driven takeup is adjusted for reels containing 2500 feet of film, and no adjustment is needed thereafter—an important advantage on a job where each projectionist has his own likes and dislikes. The initial and final adjustment assures a complete lack of wear on sprockets or film.

This GoldE takeup is adaptable to all makes of projectors for use with special V belt or regular round belting. Special models for chain drive are available at slight extra cost. A separate Bodine motor drive assembly is now being readied for production and will be announced shortly. Further details are available from the manufacturer at 1214 West Madison St., Chicago.

Many and varied projection accessories are described in a new catalog just issued by GoldE. Available to I. P. readers upon request direct to the manufacturer.

25TH ANNIV. FOR MACON, GA.

Macon, Ga., Local 507 observed its 25th anniversary recently with a party that had 50 guests marveling how a unit having only 9 members could do such a bang-up job. Guests attended from Atlanta, Rome and Columbus, among whom was Cliff Clowers who addressed the then new local 25 years ago, and W. A. McKenna, who helped organize the unit and installed its first officers. The latter and Dan Holt, well-known minstrel man, were presented with gold cards.

New Academy Theatre Test Reels

THE Research Council of the Academy of M. P. Arts & Sciences has followed up its recommendation anent Standard Electrical Characteristics for the common types of theatre sound systems with various testing reels that should prove of great value in keeping these units up to peak performance.

The Theatre Test Reel, of 1000 feet, contains representative examples of current recording from each of eight major studios which furnishes a quick check of overall quality. It contains both sound and picture, including a hi-range print which checks on amplifier capacity in relation to volume. Use of this reel demonstrates the inadvisability of having too much low-frequency electrical response which brings out noise reduction bumps, footsteps and parisitic low-frequency noises on the set.

The material contained in the reel is not a sample of the best recording available, but is typical of the average. Studios will, from time to time, submit new samples for inclusion in the reel; and all users will be given the opportunity of purchasing new samples to be spliced into their prints. By rotating and spacing this "substitution of samples" procedure, prints will be kept up-to-date at a minimum of cost, and the new samples will replace deteriorated prints.

Two Frequency Reels

The Academy now has available two different frequency reels. The first termed the Secondary Standard Multi-Frequency Test Reel, serves for routine checking of theatre characteristics and contains the following frequencies:

1000	300	2500	5000
40	500	3000	6000
70	1000	3500	7000
100	2000	4000	8000

The second, called a Primary Standard Multi-Frequency Test Reel, is intended for use in installation of new equipment or for the complete check of an electrical characteristic by equipment manufacturers, servicing organizations, or studios. The Primary Standard Reel should also be used for those particular cases when more points on the curve are to be investigated than might be necessary in a routine check. The following frequencies are included:

1000	300	2000	6000
40	400	2500	7000
70	500	3000	8000
100	700	3500	9000
150	1000	4000	10000
200	1500	5000	1000

Announcements before each frequency are included in both these reels to facilitate their use. Negatives for these reels are made all in one piece, to eliminate possible flutter or printer trouble.

For determining the acoustic response of the horn systems and of the auditorium the Academy has made available Standard Warble Tone Test Reels. As in the M.-F. Reels, Primary and Secondary Standard prints are available, in both variable area and variable density, each containing approximately the same frequency as are included in the M.-F. reels. Each frequency has a warble of ± 5% on all frequencies, this degree of warble having been chosen so that standing waves will be minimized in the auditorium.

Through the use of a microphone in conjunction with an amplifier system and a sound level meter, the acoustic response of the sound system and auditorium at the various frequencies can be determined. Under normal conditions at least five different microphone positions in the auditorium are used, and the readings are averaged to give the acoustic curve for the auditorium.

To determine the acoustic response of the speakers, the conventional method of measurement involves the averaging of 5 or more readings made with the microphone close to the speakers. However, in making these measurements care must be taken to select microphone positions which will not favor the response of either the high- or the low-frequency units.

Standard Buzz Track

To check the lateral alignment of the scanning slit the Academy offers a Standard Buzz Track. The opaque track is 86 mils wide. On the picture side of the track there is a 300-cycle tone and on the sprocket side a 1000-cycle tone. These tracks are so spaced that if the scanning slit is properly placed and of the correct dimension, no tone will be heard from the reproducer; but if the scanning slit is improperly placed toward the picture side, the 300-cycle tone will be heard, and if misplaced toward

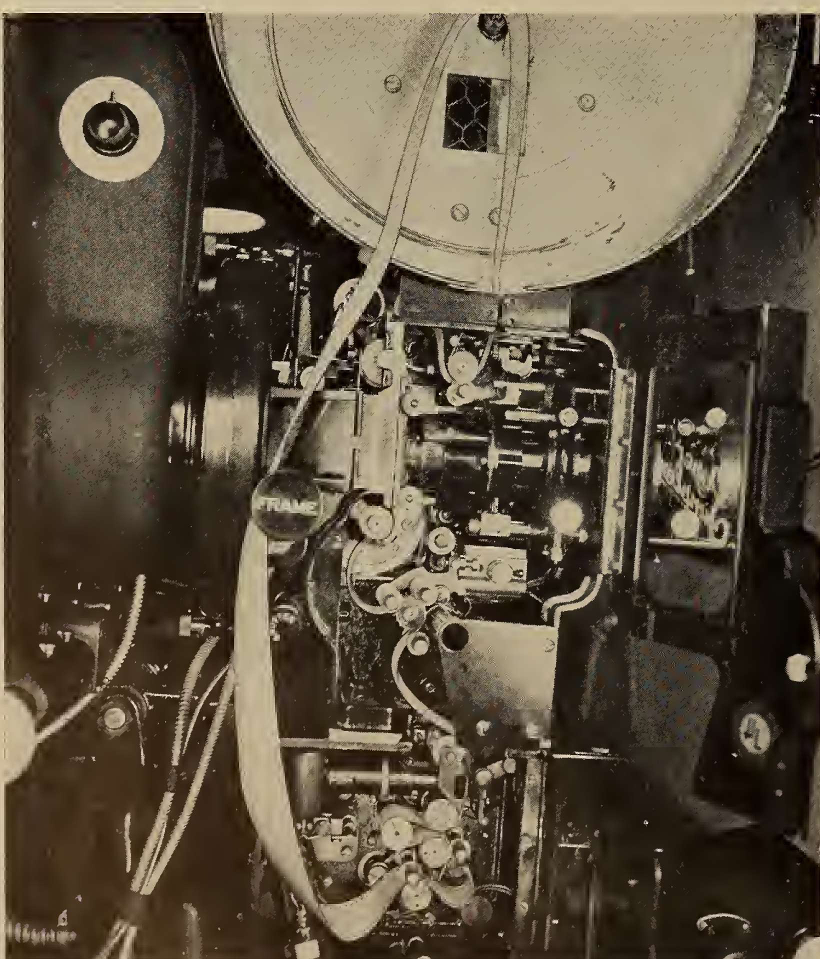


FIGURE 1

Academy projector balancing loops. This method of threading applies to all types and makes of equipment other than the exceptions illustrated in Figs. 2 and 3. Loop length—81".

the sprocket side the 1000-cycle tone will be heard.

A loop prepared from this track is run in the equipment and the scanning slit laterally adjusted until no tone is heard. In making up these prints the track placement is held to within ± 2 mils of the correct position. This track thus provides a means of adjustment of the position of the scanning slit to the current positioning tolerances.

After the scanning slit has been checked for proper dimension and placement, it is of course necessary to check the uniformity of illumination across the scanning slit, and for this purpose the Academy has made available a Standard Scanning Illumination Test Track, which contains 17 approximately equally placed 1000-cycle tracks, each with an amplitude of 6.8 mils ± 1.6%.

If the illumination on each track is constant, the output as measured with a VI meter will be constant; but if the illumination varies the amount of this variation may be read directly on the VI meter measuring the output. Of the 17 different tracks, the outside two and the inside two fall outside of a correctly positioned 84 mil slit. Therefore, with correct scanning illumination only tracks 3 to 15 inclusive will be reproduced at full output. The maximum allowable variation in output level is 3 db, that is, a tolerance of ± 1.5 db.

After this track has been run and the readings plotted against the track position, the graph so secured indicates a necessity for correcting any non-uniformity in the illumination. This correction should be by adjustment of the exciter lamp rather than by changing the lateral adjustment of the slit.

For the adjustment of rear scanning sound heads, that is, the Erpi TA 7400, there is available a rear scanning adjustment track, which consists of an opaque 84-mil sound track whose center is ± 2 from the nominal center line of 243 mils from the guided edge of the film.

The Academy Standard 7000-cycle Film contains a 7000-cycle variable density recording at 2 db below 100% modulation, in which the film response level varies less than ± ¼ db. This film is available to be used as a test film to adjust the focus and azimuth of reproducer optical systems.

The Academy recommends the use of 7000- rather than an 8000- or 9000-cycle track because of the fact that in most theatre reproducing systems the low-pass filter greatly attenuates these higher frequencies. When using either 8000- or 9000-cycle tones for adjustment it is usually necessary to remove the low-pass filter. However, at the request of a number of cooperating groups in the field, a Standard 9000-cycle film with a response level varying less than ± ¼ db is also available for special purposes.

These various test reels have been made available as a result of tours of investigation covering the entire country made by Council members during the past year. Visits to hundreds of theatres indicate in most cases a lack of sufficient test film for the projectionist and service men to provide even routine adjustment of equipment.

All of these reels are available through the Academy upon a cost price basis which in most cases, includes no negative or recording time costs, these items having been furnished by the studios at no cost.

● Projector Balancing Loops

Tours of investigation by members of the Research Council having disclosed that many theatres had no means of balancing their projectors for output level, it was decided to make available an easily used Balancing Film at a reasonable cost and with sufficient instructional information to enable the projectionist to check the volume level balance between machines as part of his daily routine (Figs. 1, 2 and 3).

Hundreds of these loops have been distributed to the field. Data assembled indicated that the longest loop necessary in any equipment would be slightly less than 7 feet. The Balancing Films were therefore made up to consist of sufficient film for two such loops. An instruction folder sent with each set shows the proper method of threading the loops into each of the common types of reproducing equipment, and outlines the proper method of checking the volume level balance between the two machines.

After the loops have been properly threaded, the machines are started and the volume output is compared by means of meter or by ear. The machines are then balanced for equal loudness at identical fader settings by adjustments normally provided in the equipment.

There has been some comment from the field regarding volume variation between reels in the same release print or between different sequencs within the same reel, requiring fader changes in the theatre during the show. Tests conducted indicate that recordings balanced for reproduction on an equipment set to the S.E.C. will invariably require fader changes when played in a theatre adjusted to a non-standard E.C. We consequently believe that a great deal of the volume variation encountered is a result of reproduction of product originally recorded for the S.C. but played upon equipment set to a non-standard characteristic.

Listening tests have been conducted in a sufficient number of acoustically average auditoriums to prove conclusively that present-day recordings are sufficiently

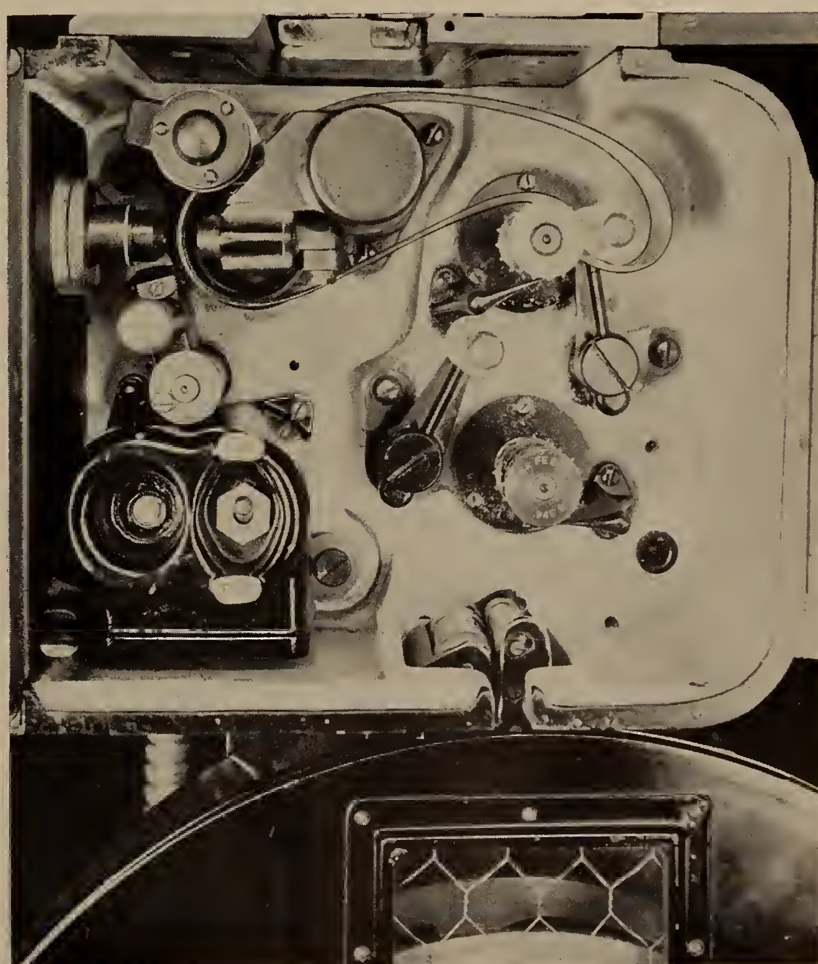


FIGURE 2

This method of threading applies to RCA PS-24 and other later similar sound heads, used with any make of picture head. Loop length—15¼".

alike to reproduce satisfactorily on an equipment set to the S.E.C.

While there have been no radical changes in recording or reproducing in the last year, there has been gradual improvement in both branches. During the last year the idea as to what constitutes good sound may have changed within the industry. A theatre considered to have good sound a year ago *may* not be so considered at the present time. Consequently, it is possible that more recent installations have been set to the S.E.C. and that a 25% estimate may be low.

Reel	*Code No.*	*Price*
Theatre Sound Test	ASTR-2	$25.00
Primary Standard, Multi-Frequency Variable Area	APFA-1	$25.00
Primary Standard, Multi-Frequency Variable Density	APFD-1	$25.00
Secondary Standard, Multi-Frequency Variable Area	ASFA-1	$17.50
Secondary Standard, Multi-Frequency Variable Density	ASFD-1	$17.50
Primary Standard, Warble Frequency Variable Area	APWA-1	$25.00
Primary Standard, Warble Frequency Variable Density	APWD-1	$25.00
Secondary Standard, Warble Frequency Variable Area	ASWA-1	$17.50
Secondary Standard, Warble Frequency Variable Density	ASWD-1	$17.50
Standard Buzz (Lateral Alignment) Track	ABzT-1	$ 2.00
Standard Scanning Illumination Test Track	A17P-1	$12.50
Standard 7000-Cycle Film	A7KC-1	3½c ft.
Standard 9000-Cycle Film	A9KC-1	3½c ft.
Rear Scanning Adjustment Track	ARS-1	5c ft.
Standard 1000-Cycle Balancing Film	ABL-1	50c ea.

Prints of all the Test Reels described in the foregoing paper or information regarding prices, *etc.*, are available at the offices of the Research Council of the Academy of Motion Picture Arts and Sciences.* Code numbers have been devised for each type of reel, as indicated, for convenience in designating the particular type desired. Prices are based upon cost and are f.o.b. Hollywood, Calif.

Inasmuch as no extensive stock of Test Films is carried on hand, a period of from five to ten days should be allowed for preparation, calibration, *etc.*, of prints.

*1217 Taft Building, Hollywood, Calif.

Coast Jurisdiction Battles

Two new threats to I. A. on the West Coast: (1) new organization named United Studio Technicians Guild of North America, claiming substantial portion of 12,000 studio workers now in I. A. ranks, appealed to N. L. R. B. for designation as exclusive bargaining agent. Guild officers and total membership thus far a deep, dark secret. (2) I. A. Local 659 (photographers) demanded jurisdiction over all first cameramen, which amounts to demand that A. S. C. be chased. Latter outfit recently obtained five-year renewal of contract with producers for first cameramen, which have not been under I. A. direction.

Moderate Industry Gains Seen By Poor's Investment Survey

Moderately improved operations will be experienced by the motion picture industry during the final half of 1939, although theatre attendance and box-office receipts are expected to hold at levels only slightly in excess of last year, according to a recent estimate by Poor's. Reduced amortization charges on films recently released under the 1938-39 schedule will allow the showing of better earnings—even should theatre attendance show no gain from the present level.

Contrasting with this fairly satisfactory outlook, a combination of political factors are disturbing. In addition to the antitrust action are (1) the Neely "block-booking" bill, recently approved by a Senate committee and (2) threats of a NLRB hearing on wages, strikes, and union activities. At this juncture, it is difficult to forecast the ultimate outcome of current and pending litigation.

As for "block-booking," arguments pro and con seem to be pretty well in balance. Whether its elimination ultimately would prove beneficial to the industry is anybody's guess. Increased competition and higher production costs would be a natural consequence.

Current estimates are that total costs for the motion picture industry's 1939-40 product will be higher than in the season currently closing, since more "A" and less "B" quality films are promised under present production plans. Unit costs also will rise, for the total number of releases will be fewer.

Because prospects indicate no important increases in theatre attendance, the incentive for building new film outlets has been dampened in recent months. Some improvement may be witnessed later this year, however, if the industry's prediction of another upswing in box-office receipts actually materializes.

RCA SERVICE PROMOTIONS

Appointment of Fred W. Wentker as assistant Photophone Division Manager, and of W. L. Jones as National Service Manager, has been announced by RCA. Wentker was formerly assistant manager of the Service Division, while Jones has been in charge of Photophone service activities. Edward C. Cahill, Photophone Division Manager, will continue to supervise the activities of the National Service Division.

ALTEC SIGNS 30 HOUSES

Griffith-Dickinson Theatres Inc., has appointed Altec to service sound equipment in 30 theatres in Kansas, Missouri, Iowa, and Nebraska.

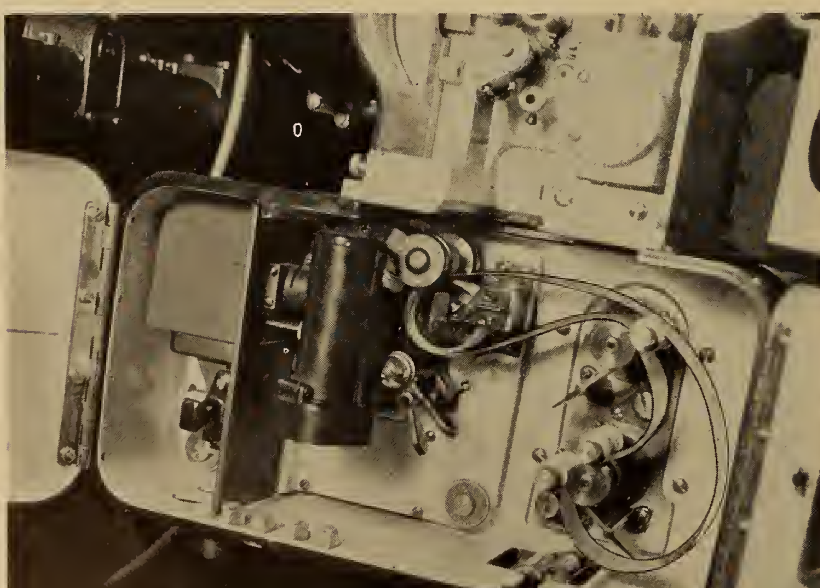


FIGURE 3

This method of threading applies to Simplex Four Star sound heads, used with any type of picture head. Loop length—26".

SUPPLEMENTARY AIDS TO SERVICING SOUND SYSTEMS

(*Continued from page* 10)

erally is to begin by drawing in all terminal boards, if any, all tubes with their socket terminals, and all transformers with their binding posts or color-coded wires, as the case may be. Resistors and condensers are too numerous in most modern amplifiers to be added in advance of the wire lines: they would be put in inconvenient locations that would needlessly complicate the work of drawing wiring, and are best inserted one at a time, as encountered.

With the major parts drawn, some prefer to proceed on a strictly physical basis, starting, say, with a power transformer, drawing all connections as they appear without regard to their electrical meaning. Others work on a circuit basis. To begin with, perhaps, heater circuits are followed, and the appropriate arrowheads and designations set down. So much is simple. The plate supply line, with its many branches, presents greater difficulty. Grid bias connections come next (they are also comparatively simple) and speech circuits last.

This method has the advantage of giving meaning to the work as it progresses, thus affording an additional check against possible error; but on the other hand it may lead into error. Consider the unusual electrical arrangement of the plate and grids of the phase inverter tube of Fig. 2.

● General Remarks

The completed drawing, whether of Fig. 1 or Fig. 2, is generally not very clear, even though accurate: it has been made with attention concentrated on wiring details rather than on draftsmanship and usually needs to be redrawn to make it compact, clear and thoroughly useful. Errors sometimes creep into the redrawing because one thinks the worst is over and relaxes his vigilance.

Circuit drawings made in times of emergency are seldom complete. For example, if the trouble is known to be some fault in the exciter lamp wiring of soundhead No. 1, there is no need to trace out all the circuits of Fig. 1. Only so much of the wiring is traced as is needed to give a complete picture of that exciter circuit, externally and internally, back to the power source; and even this can be reduced if voltmeter tests are used to show that the fault lies, say, inside volume control amplifier No. 2—that is, behind terminal 2 of that amplifier, which connects with No. 1 exciter lamp through amplifier No. 1.

Similarly with Fig. 2: voltmeter tests may show a defect in power supply to some one tube socket, of a nature that limits very narrowly the amount of wiring to be investigated, or even of such nature that no circuit drawing is needed, but only a voltmeter check of one or two resistors. In other cases, half the amplifier, or even all of it, may have to be drawn on paper before a given trouble is understood.

The latter is especially true of the most difficult and aggravating of all internal reconstructions—not an amplifier similar to that shown in Fig. 2, but a complex switching panel. The switches and terminals are drawn first, and the wiring added. A really intricate switching arrangement, of the type

used with some installations, can make the work of drawing Figs. 1 and 2 seem childishly simple by comparison.

The ohm-meter is generally trustworthy, but the voltmeter-and-battery can give misleading results. If the battery be of moderately high voltage, such as a 45-volt B battery, circuits containing electrolytic condensers may show different results according to the polarity applied; the changed reading that can follow simple reversal of the test prongs may be puzzling if this point be not understood. The voltmeter is also misleading in high resistance circuits (see I. P. for March, 1937, p. 24, and for May, 1937, p. 22). It can be used effectively only when its limitations are understood and proper allowance made for them.

PROCESS PROJECTION

(*Continued from page* 18)

the 8" focal length at which point the speed of this group will converge upon the F2.0 series.*

Light Control

DIAPHRAGM (Basic):

A heat-resisting diaphragm light control shall be provided at a suitable point in the relay condenser system to control the intensity of the light output. This diaphragm must not affect the flatness of field.

This diaphragm control in the relay type condenser system will allow carbons to be burned at their correct amperage and thus give the maximum efficiency and maximum steadiness in light output. In an equipment provided with this control, it is recommended that the carbons be burned within ±5 amperes of their rated current, as shown by the following list:

RECOMMENDED OPTIMUM CURRENTS
(*Submitted by National Carbon Co., Inc.*)

	Amperes
13.6 mm. x 22 Positive	
7/16" x 9 Orotip Negative	125
13.6 mm. x 22 Super H. I. Positive	
½" x 9 Heavy Duty Orotip Negative	175
16 mm. x 20 M. P. Studio Positive	
½" x 9 Regular Orotip Negative..	150
16 mm. x 22 Super H. I. Positive	
½" x 9 Heavy Duty Orotip Negative	195

(*Submitted by Noris Carbon Co., Inc.*)

	Amperes
16 mm. x 20 Positive—Type A	200
13 mm. x 9 Negative—Type B	225
13.6 mm. x 22 Positive	
7/16" x 9 Negative	175

LINING UP METHOD (Basic):

The design should include a means of projecting a single frame for lining up purposes, permitting as much light as possible to pass through the aperture

*Note: Since these two lenses operate in such close conjunction with the projection movement, it is recommended that lens manufacturers contact the studios to determine necessary allowances in the lens barrel to clear the projection movement employed. It is the hope of the committee that one type of projection movement will eventually be adopted as standard by the industry, thus alleviating the necessity for several styles of mountings. (See "Aperture").

without damage to the stationary film.*

PART VI. GRIDS

CAPACITY (Basic):

Grids shall be designed for mirror-type lamps to have a capacity of from 75 to 150 amperes. For condenser-type lamps the grid capacity shall be from 100 to 250 amperes. Both types are to be provided with 5-ampere steps and with a uniform resistance at each step throughout the whole range.

(Auxiliary): It has been suggested that the above conditions can be met by providing 10-ampere steps with auxiliary controls of 5 amperes to fulfill the foregoing basic recommendation.

TEMPERATURE RISE (Basic):

Grids shall be designed of such material and of a type giving a minimum resultant temperature resistance coefficient. (See "Light Variation").

CONSTRUCTION (Basic):

Grids shall be built solidly and be compact, yet easily portable.

LINE SWITCH CONTROL (Basic):

A remote control operating from the control panel of the projector, to open and close the power supply switch, shall be provided.

STARTING RESISTANCE (Basic):

Grids shall be so designed that when used in conjunction with a mirror lamp a maximum starting current of 75 amperes will be provided; and when used in conjunction with a condenser-type lamp a maximum starting current of 100 amperes will be provided. This current should be held steadily for a minimum of 30 seconds, at which time the grid should provide an easily operated means for raising the current to its proper pre-determined operating value. (See "Light Control").

(Auxiliary): The use of a switch arranged to first provide the proper starting or heating current and then by one switching operation the proper operating current, has been suggested as one method of meeting the foregoing basic recommendation. Such a pre-heating arrangement would aid in the most effective use of the grid during the start of operation. (See "Line Switch Control").

CONTACTS (Basic):

The contacts of the grid shall be so designed that the grid will give an easily operated method of resistance change and provide good electrical contacts, the efficiency of which will not vary over a period of time.

(Auxiliary): For grids designed to be used in conjunction with a projector equipped with a light control diaphragm (see "Light Control") the inclusion of a locking device has been suggested which, after a resistance change is made, gives a positive contact, rather than a contact of the rheostat or potentiometer type.

*Note: An auxiliary light source of sufficient intensity to permit lining up should be provided.

(TO BE CONTINUED)

NEW STROBOSCOPE CAMERA

An all-electric slow-motion camera capable of taking 80,000 pictures per second has been developed in Germany, reports the U. S. Department of Commerce. Known technically as a "stroboscope," the camera is designed primarily for technical and scientific research. Although other methods in use take individual exposures at a faster rate, the new stroboscope actually takes many more exposures per second through the subdivision of each individual exposure.

80,000 *Exposures a Second*

The basic principle of this stroboscope is a disc of rotating lenses that eliminates the shutter. Exposures are actually made only in the status of "optical equilibrium." To increase the number of exposures taken, a rotating disc moving counter-clockwise is arranged in front of the rotating lenses. This subdivides one exposure into 2, 4 and 8 narrow strips and thus permits the increase of the number of exposures taken to a maximum of approximately 80,000 per second.

Among the pictures shown was the movement of warm air circulating in a heated room taken without the aid of smoke. This was done by means of the mirage effect of different temperature air strata. The discharge of electric sparks over insulators and photographs of flying bullets hitting suspended steel wires were also shown. Pictures of flying bullets clearly showed the air waves in front of the bullet and the movement of the severed wire, according to the report.

New Rectifer Fuse Indicator

PROJECTIONISTS will welcome the advent of the Forest Fuse Indicator which, using Neon glow lamps in a special circuit designed for connection to a 3-phase, 220-volt a.c. line, will give positive indication of a blown fuse or other open connections in the line which give rise to single-phasing of the rectifier.

A blown fuse should be replaced immediately, as severe overload will result from continued operation of the rectifier with the line in this condition. Spare tested fuses should be kept on hand at all times.

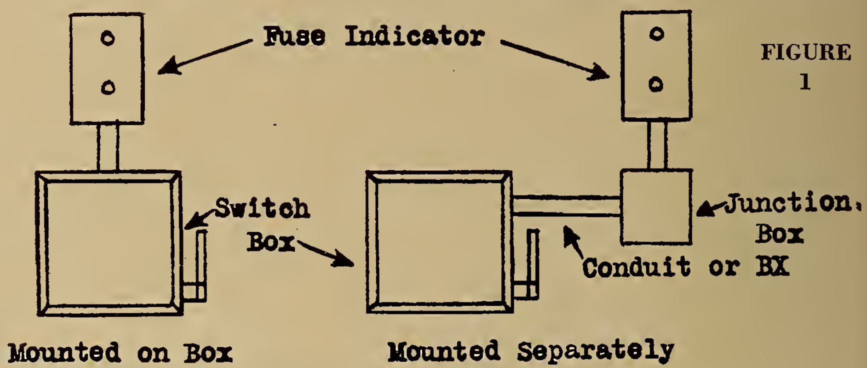


FIGURE 1

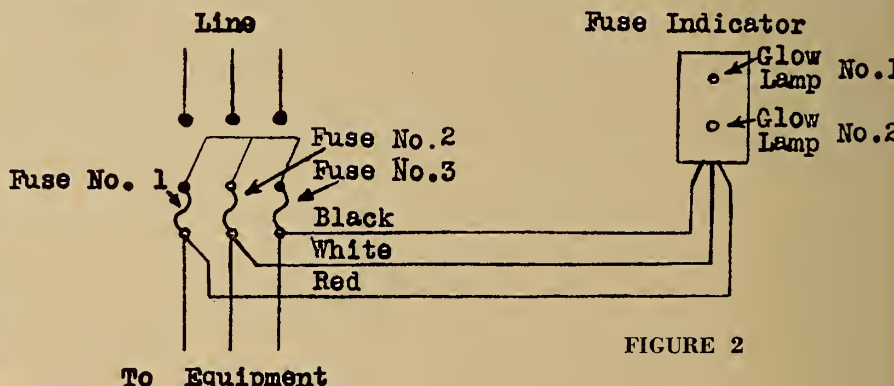


FIGURE 2

Within the rectifier cabinet are two fuses for each rectifier—two sets of 2 fuses each in the twin unit, and one set in each single machine. These fuses are installed for the protection of the rectifier units and are connected in the secondary circuit of the rectifier between the transformer and the units.

A blown fuse in this circuit will not be shown by the Fuse Indicator. A positive indication of a blown secondary fuse will be given by a drop in amperage at the arc being supplied by the rectifier in which a fuse is blown. There will also be visible on the screen a flicker or change in light intensity when the affected rectifier is in operation; whereas a blown line fuse will affect both arcs.

When single rectifiers are installed, a separate Indicator should be connected to each line switch for proper protection. A single Indicator is sufficient for the twin machine. In all cases the Indicator should be installed

where it will be readily visible from the operating position.

● **Installation Procedure**

The Indicator should be installed at the switch box controlling the equipment to be protected, either by direct mounting on the switch box with conduit nipple supplied, or by means of a separate junction box connected to the switch with conduit or BX if room is limited. This line of course may be extended to any length to place the Indicator where it is *readily visible.* Fig. 1 shows this installation.

Each unit is supplied with color-coded wires long enough to reach switch connections if mounted directly on the switch box. If connected as shown in Fig. 2 the lamps will not only indicate a blown fuse but will also show which fuse is blown. Connected in this manner both glow lamps will light when the switch is closed. If glow lamp No. 1 does not light, it is an indication that fuse No. 1 is blown; No. 2 lamp out indicates No. 2 fuse is blown; and both glow lamps out indicate No. 3 fuse blown.

The Forest Indicator will also show a blown fuse elsewhere in the line between the switch box and the meter, but will not indicate which fuse is blown unless all wires leading from the meter are properly identified. The lamps used in the unit are G.E. Neon glow lamps type G-10, 1 watt, and are readily obtainable from any electrical jobber.

Complete installation and operating instructions are given on the card accompanying each Indicator. This card should be mounted on the wall near the Indicator for ready reference.

A.F.M. Says I.A. Grabs Jobs; Wants Aid on Theatres

A.F.M. Convention instructed executive board to confer with I. A. relative to alleged attempt of latter to extend jurisdiction by moving in on spots—cafes, hotel rooms playing bands, radio stations, dog tracks, symphony halls, dance halls, p. a. systems—which musicians feel belong to them more so than to I. A. Both organizations parties to mutual assistance pact of long standing.

A.F.M. also wants movie producers to hire union musicians in at least all producer-controlled theatres, but in no event to extent of not less than a total musician wage of five million annually. Failure to comply with this demand would mean that A.F.M. would invoke I. A. pact and request latter to refuse service in affected theatres on and after Sept. 4 next.

Govt. Suit Threat Nixed L.U. 306 New York Strike

Threat of criminal prosecution averted recent N. Y. Local 306 projectionist strike, it was revealed by testimony of asst. U. S. attorney general Thurman

Arnold before a Senate committee. L. 306 threatened city-wide strike if producers did not refuse to service some 70-odd non-306 theatres. Said Arnold:

"Recently the movie people came in and complained that the projectionists' union in New York was going to strike and close many of the picture houses in New York unless they (the producers) refused to furnish films to the largest non-union independents. It was to be a secondary boycott.

"We called the labor union down and they said, 'Well, we think it is all right. We believe that Mr. Justice Brandeis' dissenting opinion in the Duplex case is now the law, with the new (Supreme) Court.'

"I said, 'I do not know anything about that. It may or may not be. I only point out to you one thing, that we cannot give you a free injunction ride to the Supreme Court if you happen to be wrong about this thing; and I think you are. In this particular case, it means criminal prosecution.'

"The strike was ended; and everybody is going along perfectly happy."

Projectionist Day at Fair

Projectionist Day will be observed with special ceremonies at the New York World's Fair on a date early in September. Joe Basson, head of Local 306, has appointed a committee on arrangements consisting of George Edwards, Otto Kafka, C. Eichhorn and P. A. McGuire. The active participation of all locals in the U. S. and Canada will be solicited, at least to the extent of sending a representative. I. A. officials will participate.

PROTEST ITINERANT SHOWS

Assoc. Theatre Owners of Indiana reports that 198 towns are being serviced by 16 mm. transient exhibitors, as contrasted with the 447 legitimate movie houses in the State. Reduction of 35 mm. standard release prints to 16 mm. was scored by A. T. O.

NOVEL COOLING-OFF PROCESS

Projectionists at the Irvin Theatre, Bloomington, Ill., recently walked out on an evening performance, occasioning refunds to a large audience. Complaint was lack of ventilation in projection room and demand for more fans. Several fans were installed in room the following day, and the crew returned to the job.

RELIEF FROM EYE-STRAIN

Projectionists often suffer from eye-strain, and it is obvious that a treatment to reduce the irritation plus an expedient to remedy the cause is the solution to the problem. A doctor prescribed for one projectionist the following solution:

Concentrated boric acid	2 parts
Camphor water	1 part
Rose water	1 part

Shake thoroughly. Bathe the eyes, using eye-cup, morning and night. Don't let up the treatment when the condition improves. This may not work for everybody, but it benefitted considerably one man.

To cut down irritation use glasses that have a tinted lens, to reduce the irritating waves that are harsh on the eyes. A lense ground with a slight convexity, called a toric lens, will reduce further chances of glare. Consult your optician regarding the proper choice of lens.

UNIFORM PRINTS WITH NEW FILM DEVELOPER

A superior film developer compound was described by J. R. Allburger, of RCA, at the recent S.M.P.E. convention. This new compound will make possible more faithful development of the sound track and picture negative, with uniform results for all prints released to the theatres. Ordinary developing compounds must be replenished frequently during the developing process and the balance of the chemical formula is likely to be disturbed in such a way as to introduce variations in the quality of the finished film prints. In preliminary tests, the new RCA "Aluminate" developer processed six times as much film footage without replenishment as did ordinary developer.

Besides economy of chemical costs, the new Aluminate developer was said to have a hardening agent which serves to protect the emulsion on the film against scratches and abrasions from usage and handling.

N. Y. STATE CHECK-UP

Since the death, by burning, of several projectionists in N. Y., State troopers have been checking closely the condition of theatres in small communities and have ordered the closing of several until construction changes were made. Enforcement of safety regulations in buildings is vested in the State Police where no local supervising officer or body exists.

A number of small houses do not qualify from every angle of safety, some observers assert. A very rigid enforcement of safety provisions might close many of them.

NEW ALTEC TERRITORY

Altec Service Corp. has created a new service territory in the Philadelphia district, comprising eastern shore of Maryland, Delaware, and Virginia. W. M. Schubert will supervise from Dover, Del.

INTERNATIONAL PROJECTIONIST

AUGUST 1939

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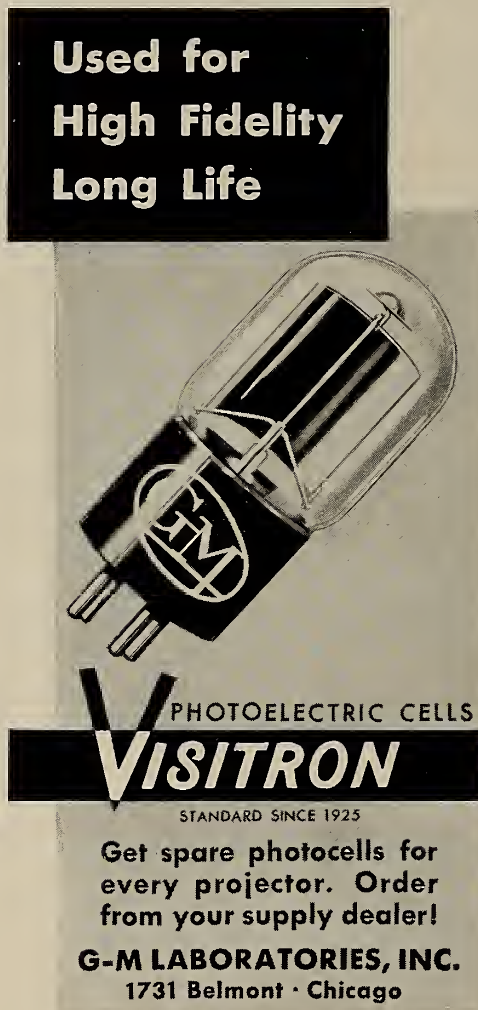
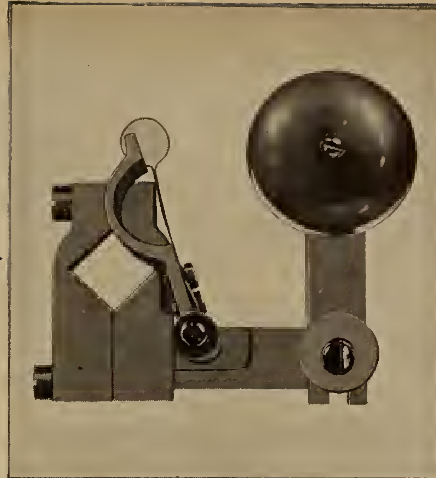


TO PROJECTIONISTS!

Visitron cells are available for every type of sound projection equipment. Theatre supply dealers can advise the correct cell for your equipment. Buy from your supply dealer. If you wish to have your old cells tested without charge, write to G-M Laboratories, Inc., for instructions for shipping. Information furnished promptly.

Announcing—

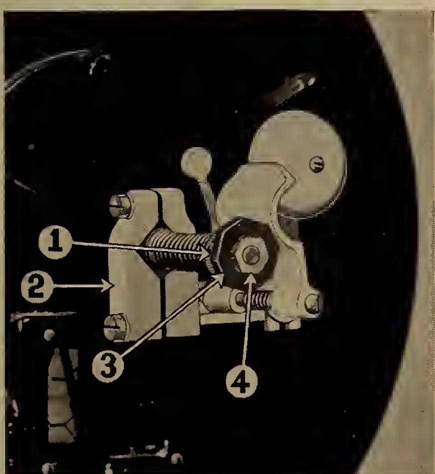


The New and Wholly Different

STRONG REEL-END SIGNAL

(Patent Pending)

Does Not Touch the Film or Reel!



1. **Regular spring lock nut.**
2. **Signal clamped to magazine housing.**
3. **Fibre disc.**
4. **Lock nut for fibre disc.**

The story on this new and unique device is as simple as the unit itself. Here it is:

1. Does not touch the film or reel.
2. It is *strictly mechanical* and requires no batteries, no transformers, no governors, and no pre-setting by the projectionist.
3. Is not dependent upon any change in the normal smooth operation of the projector.
4. It is installed within 5 minutes, requiring no drilling.
5. Once installed, forget it—as was conclusively demonstrated by 1200 tests under practical conditions in various projection rooms.

INSTALLATION: A multiple-sided fibre disc (3 in photo to the left) is mounted on the end of the upper magazine shaft and is held in place by the locking nut (4). The signal is clamped onto the outside of the magazine, the vibrating arm resting against the fibre disc. This arm is held against the disc by a spring. Mounted on this arm is a vibrating reed having a lead weight on its end.

OPERATION: As the film in the upper magazine decreases, the reel naturally revolves faster, as does the shaft. When 115 feet of film remain on the reel, the fibre disc on the shaft end is revolving at just the correct speed to impart the correct frequency to the vibrating reed so as to cause contact with the bell. This frequency of vibration continues for about 15 seconds, during which time the lead hammer is contacting the bell.

After 15 seconds the fibre disc is revolving so fast that it has exceeded the vibration frequency at which the bell will be contacted—thus the bell stops ringing. Thus, 75 seconds before the end of the reel the bell begins to ring, continuing distinctly for 15 seconds, after which period of time it ceases. The duration of the bell-signal can be increased or decreased about 15 seconds by simply moving the arm to either the left or the right.

Install it and Forget it— It is Always Set!

Projectionists are enthusiastic about this new and novel Strong Reel-End Signal on the score of its simplicity, absolute reliability of operation, ease and speed of installation—no less than because it does not touch either the film or the reel. The first lot of Strong Reel-End Signals was quickly disposed of to several large theatre circuits, including Paramount, which companies approved the unit immediately upon demonstration.

Made by the manufacturer of the famous Strong Zipper Changeover, this Reel-End Signal is sold on the same basis—*your money refunded if you are not thoroughly satisfied.*

The Strong Reel-End Signal can be used on all projectors which use standard 4-inch hub reels. It is distributed by all theatre supply dealers. The next time you visit your favorite supply dealer ask him to demonstrate how this unique Strong Reel-End Signal will afford you positive protection on all change-overs. Once you try this unit you will never again be without it. Orders filled promptly.

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International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

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Monthly Chat

THE answer to the query "What's new?" concerning the projection field during the past half year would necessarily have evoked the reply, "Nothing, nothing at all," so dull and dreary has been the picture relative to activity by manufacturers, to whom the field must look for technological advances. But suddenly ("and the birdies sing") the wind shifted and a shipload of new developments made port. To enumerate:

The new series $f/2$ lenses made by Bausch & Lomb has been mentioned herein, but particulars are lacking. Now, forsooth, along comes International Projector Corp. with a socko new projection room installation, complete from base to stage speakers and including arc lamp, for the smaller theatres. (This lamp, incidentally is a low-intensity job. The economic reasons for this unit we savvy but the technical reasons elude us.)

Mention of lamps brings to mind the new Forest Suprex job concerning which no little roaring will emanate from the Jersey shores shortly. These boys also have a new screen in tow. More noise.

The estimable Karl Brenkert, he of the lamp and effect-machine clan, dived into the projector field with a splash heard around the world by means of a new 35 mm. theatre unit. Thus far the development has been the topic of much conversation and scanty down-to-earth meaty data, the aforementioned sponsor being coy and playing hard-to-get, despite the fact that a dozen jobs have been spotted in widely separated locations. We'll get him—or else. There must be something tonic (who said "toxic"?) about these theatre projector waters, because the Holmes Co., of Chicago, which recently supplied RCA with a batch of 35 mm. jobs, is reported as having a tentative toe in the pool.

Not to be outdone by mere manufacturers, Larry (Essannay) Strong, a projection mug from Chicago, pops up with Film-Weld, a unique film binder which is literally mopping up the field, and matches this with a new reel-end signal that touches neither reel nor film. A couple energetic Jerseyites, Heyer and Shultz by name, finally make good on the old promise to produce a practicable metal mirror—and selling them! The irrepressible Morrie (GoldE) Goldberg is chortling about Underwriters' approval for his new Micro-Matic enclosed rewind, and he exhibits boundless enthusiasm about a new oil-drive takeup.

Ben Schlanger, the architect with a passion for proper theatre sight lines, is bent upon abolishing masking and letting the screen image light spray out over all sides of the picture sheet.

Dr. A. N. Goldsmith has not yet constructed a model of his completely automatic movie theatre, but we expect news of this thrust as soon as this eminent human technical encyclopedia finishes the job of masticating mentally his 97 television patents.

INTERNATIONAL PROJECTIONIST

VOLUME XIV NUMBER 7

AUGUST 1939

Film Projection by Discharge Lamps

This communication from what is generally regarded as the outstanding technical research laboratory in the world treats with a subject of extreme interest to projectionists. The Philips organization, having pioneered in the development of the mercury vapor discharge lamp, is naturally interested in its progress—a fact which explains in part the unfavorable comment anent the carbon arc contained in the appended article. Elements other than the carbon arc in the projection process being "up to snuff," the carbon arc still remains the ideal light source and remains the means for the projection of extraordinarily fine screen images in thousands of theatres daily.
—Editor.

By *G. HELLER*
PHILIPS TECHNICAL LABORATORIES
EINDHOVEN, HOLLAND

THE high intensity of illumination of the film which is necessary for kinema projection requires a very intense light source. It was therefore to be expected that the light source would be used for this purpose which had the greatest brightness known, namely the carbon arc. This light source, however, has various technical objections. The crater changes in shape and size and, moreover, tiny particles are thrown out of the arc which soon cause a decrease in the reflecting power of the condensing mirror.

These objections have led to the attempt to replace the arc lamp by an electric filament lamp. With the increasing size of kinema theatres it was, however, found impossible to satisfy the also increasing demands of the public as to brightness of the picture. It is therefore understandable that a light source has been sought with a greater surface brightness than a filament lamp and easier to operate than the usual carbon arc.

Such a light source was discovered several years ago in the water-cooled mercury lamp, which easily matches the carbon arc and even the so-called "high-intensity" arc in brightness. This light source has none of the aforementioned disadvantages and has, moreover, the advantage of developing much less heat than the carbon arc.

Because of the necessity of water cooling, and because of the linear form of the light source, new problems were presented which made it necessary to consider anew the construction of the illumination objective. On the other hand, the small dimensions of the mercury lamp and its slight heat development offered new possibilities for the construction of the whole projector. These considerations have led to the construction of an entirely new installation for film reproduction which makes full use of the advantages offered by the water-cooled mercury lamp.

The most important data are given in Table A.

● The Light Source

The mercury lamp for film projection dissipates an energy of 1,000 W over a length of 12.5 mm. between the electrodes. It has an internal diameter of 1.8 mm. and an external diameter of 4 mm. The walls are of quartz and are

Length of the discharge	12.5 mm.
Internal diameter	1.8 mm.
External diameter	4 mm.
Pressure of the mercury vapour	100 Atm.
Power { mercury lamp	1,000 W
Power { transformer + rectifier	500 W
Current	2 A
Working Voltage	500 V
Ignition voltage	800 V
Light flux	60,000 lm.
Surface brightness the axis of the discharge	57,000 c.p./sq.cm.
Efficiency	60 lm./W

TABLE A

cooled with water. Two tungsten wires led in through the ends of the tube serve as electrodes. In addition to a small amount of mercury, the tube contains an inert gas filling of low pressure. This inert gas is necessary for ignition.

For use in film projection the tube must be fed with direct current. A transformer and a rectifier are used for this purpose.

● The Optical System

The requirements of the optical system for the projection of films and of lantern slides are to a certain extent opposite to each other. With films the film window is placed at the point where the beam emitted from the light source and concentrated by the condenser has the smallest diameter. In the projection of much larger lantern slides, the narrowest part of the beam is no longer chosen but on the contrary, exactly the place where the beam has its greatest diameter, *i.e.*, immediately behind the condenser.

The arrangement ordinarily used for lantern slides is much more satisfactory for mercury lamps, and actually forms the basis of the construction of the new installation for film reproduction.

Figure 1 gives a cross-section and view from above of the optical system. The mercury lamp 1 is in a metal boat which is shown separately in Fig. 2. This boat is placed in a tube (see Fig. 3) through which the cooling water flows. The boat is closed by a plane glass, 2. In front of this is a plano-convex lens, 3, which receives the light from the mercury lamp over an angle of divergence of about 90 degrees.

This lens has a relatively small refraction because one surface is bounded by water instead of air. Therefore a second condenser lens, (4 in Fig. 2), must be used. Between the two lenses, 3 and 4, space is left for the rotating sector.

The light which the lamp emits in the backward direction is directed forward by a cylindrical mirror, 5. It is desirable to concentrate as much light as possible in the neighborhood of the light source. A certain lateral deviation is, however, necessary because, due to the strong refraction of the quartz, it is impossible to send light through the free space between the constricted discharge and the inner wall of the mercury tube.

The action of the rear mirror may be seen in Fig. 4. If the path of the rays be examined in a transverse cross-section, four images are seen to appear beside the discharge, which together form a lighted surface about 8 mm. wide. In the longitudinal cross-section there is no focusing, but this is unnecessary because, due to the oblong form of the source, the beams have a sufficiently great angle of divergence in the longitudinal cross-section.

The direct and reflected light of the mercury lamp must now be used to illuminate the film uniformly. A gradual variation of brightness, namely a decay of brightness towards the edges of the film, is by itself not a great objection, since the eye is also only slightly sensitive to differences in brightness. The eye is, however, very sensitive to small changes in the spectral composition of the light. Since the condenser is not completely achromatic, so that the light of the blue mercury line is distributed over the film in a somewhat different way from the green mercury line, very disturbing color differences might occur if there were a slight irregularity in the illumination of the film.

● Light Production, Color

When such differences in color are observed, it has been found sufficient to place a frosted glass plate between the source and the condenser. The spreading of the light by this plate is only slight, because it is immersed in water, *i.e.*, in a medium with practically the same index of refraction. Nevertheless this scattering is enough to make the illumination of the film absolutely uniform.

The light flux which is directed on

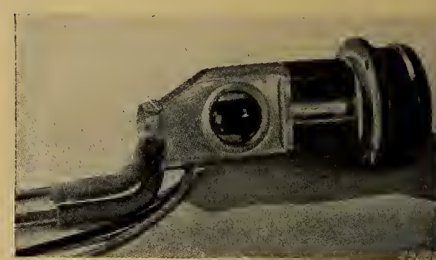


FIGURE 3

The tube which contains the boat for the mercury lamp. The boat is slid in from the right and fixed in position with a hollow screw in such a way that the flange forms a watertight closing. Afterward the large cover is set on the tube from the right. The electrical contact is first made through this cover between the positive terminal of the supply voltage and the pin of the boat. During assembly or demounting, therefore, the lamp can never be under tension.

the screen is practically the same as that of a carbon arc of 45 amperes, and, with the sector rotating and without film, it is about 2,500 lumens. The light is bluish-white in color and resembles that of the so-called high-intensity arc.

The spectrum of the light of the mercury lamp is, as is well known, not

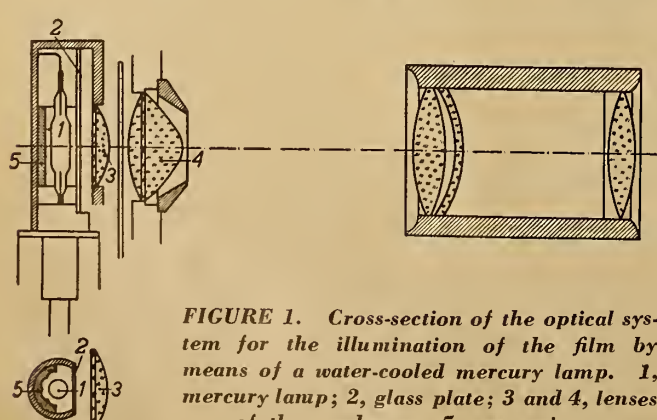
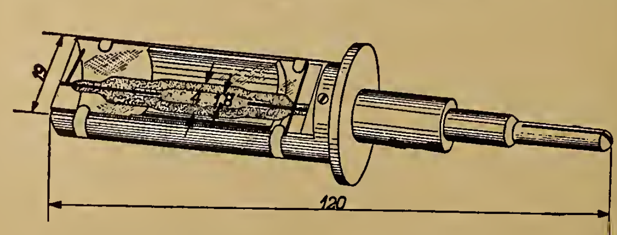


FIGURE 1. Cross-section of the optical system for the illumination of the film by means of a water-cooled mercury lamp. 1, mercury lamp; 2, glass plate; 3 and 4, lenses of the condenser; 5, rear mirror.

FIGURE 2. The boat with the mercury lamp. The numbers give the chief dimensions in mm. The projecting pin on the right is one of the electrical connections, the other is formed by the container of the boat. The cooling-water flows in on the left and out through a hole in the rear wall.



Section (Å) / Light source	4,000-4,200	4,200-4,400	4,400-4,600	4,600-5,100	5,100-5,600	5,600-6,100	6,100-6,600	6,600-7,200
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Electric lamp	0.005	0.058	0.25	5.4	33.5	42.7	16.6	1.54
Carbon arc	0.013	0.116	0.43	7.4	37.3	40.0	13.6	1.13
Sunlight	0.016	0.175	0.64	9.2	39.3	38.2	11.6	0.91
Daylight	0.025	0.26	0.91	11.1	40.8	36.2	9.9	0.73
High-intensity arc	0.050	0.27	0.97	10.2	43.7	33.2	10.6	0.94
High pressure mercury lamp for film projection	0.042	0.53	0.87	4.6	52.6	37.6	3.4	0.25
More highly loaded mercury lamp with red sector and yellow filter	0.03	0.4	0.9	4.4	50	37	6.8	0.5

TABLE B

continuous but consists of a number of lines, chiefly a green one, a yellow one and several blue ones. However, thanks to the high pressure to which the mercury vapor is subjected, a continuous background appears between the lines, so that with increasing loading of the mercury lamp the spectrum begins more and more to resemble that of an incandescent body.

The spectral composition is of particular importance when color films are shown. In that case it is not enough to require that the light source be "white," but the additional requirement must be made that the light must have about the same relative distribution in the various wave-length regions as daylight.

In Table B the distribution is indicated of the light flux of the mercury lamps for kinema projection over different sections of the wave-length scale, and compared with that of various other sources of white light. The choice of the sections is adapted to the properties of the eye.

It may be seen from the table that the radiation of the mercury lamp is quite similar to that of daylight in the middle sections, 3 to 6. In the blue sections, 1 and 2, the intensity is about twice as high. This excess of light can be absorbed by a yellow filter. The highest relative deviations appear, however, in the red sections, 7 and 8, where the intensity of the mercury lamp is only one-half that of daylight.

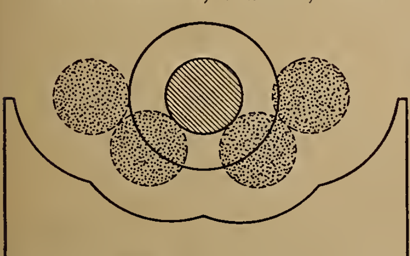


FIGURE 4
The action of the rear mirror

The intensity of the red radiation can be increased by using red-transmitting sectors instead of opaque ones on the rotating sector disc. A further increase of the intensity in the red is possible by increasing the specific loading of the mercury lamp.

Experiments have shown that upon the application of these measures a satisfactory color reproduction is possible. The last line in Table B gives the spectral distribution of a mercury lamp with increased load provided with a red rotating sector and a yellow filter.

The energy consumed by the mercury lamp (with rectifier) is 1.5 kw. In the case of a carbon arc of 45 amperes the total consumption is about 3 kw, so that a saving of 50 per cent is achieved. Because of this the heat development of the mercury arc is much less, and moreover about 90 per cent of the heat radiation is removed by the cooling water.

● Arrangement of Installation

Following the foregoing explanation of the optical system we shall consider the installation for film reproduction as a whole. Fig. 5 is a photograph of the apparatus. The compact structure, which was made possible by the very small dimensions of the light source, is immediately striking.

The lamp forms, as it were, a unit with the film window. At the spot where the arc lamp ordinarily stands are the film drums. The arrangement has made it possible to mount one above the other the two projectors which are necessary in order to be able to change reels of film without interrupting the performance. This means a great saving of space.

In order to align the projectors in the vertical plane, they are mounted in a ring, as may be seen in the photograph, so that they can be turned about a horizontal axis. In the horizontal plane the projector cabinet which contains the ring can itself be turned a few degrees.

In each of the projector cabinets there is the optical system with the necessary water-cooling, and further the scanning apparatus for the sound track with the first stage of the necessary amplification. In the cabinet also is the mechanical arrangement for moving the film across the optical system and the sound head. In the cabinet below are the amplifiers and the supply apparatus.

In the middle of either cabinet is the motor for moving the film. To the left of the motor the projection arrangement is mounted in a ring. Behind the motor are the two tubes which conduct the cooling water to the jacket of the mercury lamp. The screened cable which connects the photocell for sound scanning to the photocell amplifier is in the upper left-hand corner of each projection cabinet.

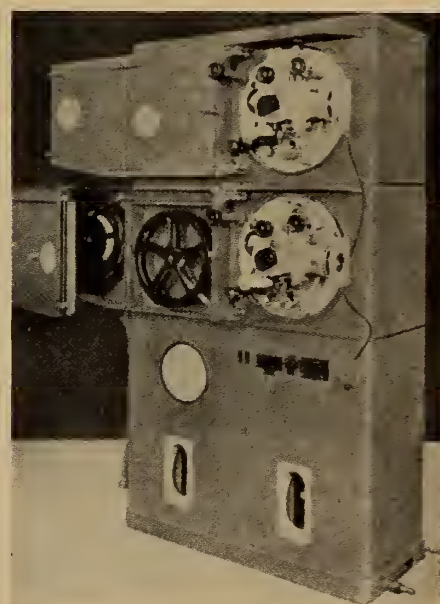


FIGURE 5
The Philips double film reproduction installation FP2. It consists of two projectors one above the other. The lower cabinet contains the amplifiers, the supply apparatus and the cabin loudspeaker. The two projectors are housed together with the necessary arrangements for sound scanning; behind each projector there are two film drums.

Figure 6 gives pictures of several details of the mechanism of the projector. The whole mechanism (mercury lamp and lenses) can be moved in a vertical direction (see A) by means of a knob. In this way the position of the film window can be so adjusted that in the

positions of rest of the rotating sector it corresponds exactly with the position of one film picture (framing). Another knob in the middle of Fig. 6 is that of a revolving head which contains two mercury lamps. By giving this knob a half turn the lamps can be interchanged. At the same time the connections for electric current and cooling water are switched over to the lamp put into use. The switching on takes place in four steps:

● Starting the Equipment

1. Switching on of motor and primary winding of transformer. 2. Motor brought up to normal number of revolutions. 3. Ignition of the lamp. 4. Current in lamp raised to normal working strength. The lamp current can be read off from the ammeter. In the lower left-hand corner of Fig. 6 is the system for sound scanning. Below to the extreme left is the exciter lamp. Diagonally upward follow: a condenser, a slit,

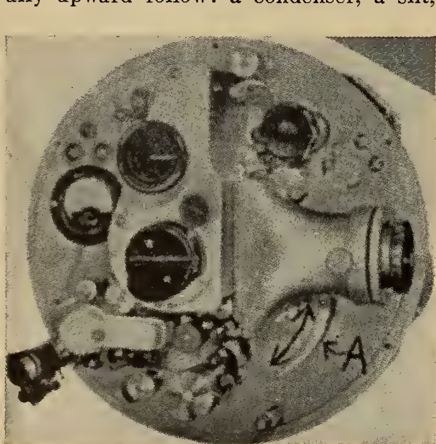


FIGURE 6

Front side of projector

a reversed microscope lens which focuses a reduced image of the slit on the sound track, and a photocell contained in the grey box.

On the cover of the upper projector cabinet the arrangement for projecting lantern slides is mounted. It consists of two mercury light sources, each with its condenser and projection lens. The two systems work alternately. Upon changing from one slide to another the beam of light of one system is gradually cut off by a lever switch with the help of a diaphragm set up behind each objective, while at the same time the beam of the other system is raised to full strength.

NEW STUDIO PROJ. LOCAL

The organized studio projectionists are not in the least secretive about the fact that they now have their own unit in the I. A.—Local 165—and have established headquarters at 708 North LaBrea Ave., Los Angeles. A membership of 272 studio men (the "economic royalists" of the projection craft) are enthusiastic about their new baby and feel that they provide the nucleus for a very successful Local.

S.M.P.E. Projection Practice, Exchange Committees Report Progress

Appended hereto are the current reports by the Projection Practice and Exchange Practice committees of the S.M.P.E. The former group has several important projects under way, including an investigation of screen brightness and means for measuring it, and an inquiry into sources of theatre power supply. The Exchange group is primarily interested in improving methods of handling prints, particularly in theatre projection rooms.

PROJECTION PRACTICE REPORT

A NUMBER of important matters are before the Committee at this time. As detailed information on these matters is not yet complete, they will be reported on more fully at a later date. Among these projects are:

(1) Study of screen brightness and methods of measuring it.

(2) Problem of obtaining simple and practicable meters for measuring screen illumination and brightness.

(3) Study of screen sizes and placement, and seating arrangement.

(4) Study of tolerances and tensions permissible in motion picture projection equipment and means of measuring and checking the values.

(5) Revision of the NFPA Regulations for Handling Nitrocellulose Motion Picture Film.

(6) Survey of the power requirements of motion picture theatres.

● Screen Brightness

The Committee has had under consideration for quite some time the subject of measuring reflected light, and while it is relatively easy to obtain meters which are calibrated correctly on diffused light, the readings obtained from motion picture screens are greatly influenced by the fact that all commercial screens are in some degree specular, that is, not completely diffusing. This fact precludes the possibility of easily making absolute brightness measurements, and for this reason the Committee is having tests made on various types of screens to determine whether an empirical method of testing can be established and whether thereafter it can be systematically correlated to a primary and precision method yet to be devised.

The report of the Committee, published in the November, 1938 *Journal*[1], contained the complete recommendations of the Committee with regard to the National Fire Protective Association Regulations for Handling Nitrocellulose Film. These proposals were submitted to the NFPA and are now being considered by their Committee on Hazardous Chemicals and Explosives. It is expected that final action on this revision will be taken at the May convention of the NFPA at Chicago.*

The Committee feels gratified that a great number of its proposals have been accepted by the NFPA Committee without modification. As it has been many years since the last issue of the "Regulations," this revision fulfills an important need of the industry in bringing theatres up-to-date as regards equipment and installation.

● Power Requirement Survey

A great deal has been written in various non-technical trade publications on the subject of theatre lighting and power equipment operating characteristics. Also, many attempts have been made to relate the lighting and power equipment installation to total energy costs. Developments in the motion picture field have reached the stage where every important operation is related in some manner to electrical apparatus of widely varying types.

Some exhibitors and projectionists do not have reliable sources of information to determine whether or not their equipment and their methods of operation conform to present-day trends. There has long been a need for a comprehensive report showing the various types of electrical equipment, their load characteristics, and their use and cost of operation. The Committee now has in progress the preparation of such a report.

EXCHANGE PRACTICE COMMITTEE

During the past year meetings were held regularly each month. Although there is little material of a specific nature to be reported at this time, these meetings have proved of great value in providing periodic contacts among the heads of exchanges of the various companies, and to permit interchange of ideas and discussions of technic, administration and conduct, to the general betterment of exchange operation.

Some of the studies initiated last year have not yet been completed. For

(*Continued on page* 25)

[1] I.P. for Nov., 1938, p. 12.

*NOTE: These proposals were approved without important modification, by the NFPA at its recent Convention, as reported in I. P. for May, 1939, p. 15 ("Many Important Changes in NFPA Projection Room Regulations").

The Fundamentals of Mathematics

By *GEORGE LOGAN*

SOUND DEPARTMENT, METRO-GOLDWYN-MAYER STUDIOS

III. Multiplication, Division, and Factoring of Polynomials; Ratio and Proportion.

It will be a help if the reader digest each article as it appears, for the ideas presented in subsequent sections hinge upon an understanding of topics discussed in earlier sections. Further, it is desirable that the issues of this series be cached away after reading, as back-reference may be useful before the series is completed.

The various examples given throughout the series will be best understood if the reader will work them out on paper, duplicating, step-by-step, the solutions given in the text.

IN the second section of this series some multiplication was undertaken with the purpose of showing how to handle positive and negative signs, and how to perform the multiplication operation upon monomials. A monomial, as we have seen, is a single algebraic term which is composed of a coefficient and one or more letter factors. Thus $7a$, $-2b$, $16x^2y$, $7z$, are monomials.

It is our purpose now to extend our ideas on multiplication so that we can multiply algebraic quantities made up of several terms—that is, polynomials. A *polynomial* is merely a group of monomials separated one from the other by the signs of addition or subtraction. Thus

$$7a-2b+16x^2+7z, \quad \text{and}$$
$$4ac+3bc+9c^2$$

are polynomials.

Let us consider first multiplication of a polynomial by a monomial. *Multiply each term of the polynomial by the monomial, and add together the individual products with due regard to sign.*

Find the product of $8c^2+4s-9t^2$ and $2c$:

$$\begin{array}{r} 8c^2+4s-9t^2 \\ 2c \\ \hline 16c^3+8sc-18t^2c \end{array}$$

Find the product of $-6x+9d^2-4$ and $3s$:

$$\begin{array}{r} -6x+9d^2-4 \\ 3s \\ \hline -18xs+27d^2s-12s \end{array}$$

From this point it is a short jump to multiplication of a polynomial by a polynomial. *Multiply each term of the first polynomial by each term of the second polynomial, and add together the individual products with due regard to sign.*

Find the product of $4a-4b$ and $3a-3b$:

$$\begin{array}{rr} & 4a-4b \\ & 3a-3b \\ \hline & -12ab+12b^2 \\ 12a^2-12ab & \\ \hline 12a^2 & -24ab+12b^2 \end{array}$$

Find the product of $7x-4y$ and $3x+6y$:

$$\begin{array}{rr} & 7x-4y \\ & 3x+6y \\ \hline & +42xy-24y^2 \\ 21x^2-12xy & \\ \hline 21x^2 & +30xy-24y^2 \end{array}$$

Whenever, in multiplication of polynomial by polynomial, some individual products are similar terms, the similar terms are placed in a column for convenience in adding, as we have done above. But when similar terms are not formed, as in the appended example, the terms are not placed in columns.

Find the product of $7sx-3y$ and $2m+4t$:

$$\begin{array}{rr} & 7sx-3y \\ & 2m+4t \\ \hline & +28sxt-12yt \\ 14sxm-6ym & \\ \hline 14sxm-6ym & +28sxt-12yt \end{array}$$

Thus far our examples have been polynomials of two terms. Herewith is an example of multiplication of two polynomials, each of which is composed of three terms.

$$\begin{array}{rr} & 6k\ +4t\ +3m \\ & 4k\ +4s\ -2m \\ \hline & -12km-8tm-6m^2 \\ & +24sk+16st+12sm \\ 24k^2+16kt & +12km \\ \hline 24k^2+16kt & +24sk+16st+12sm+\ 0\ -8tm-6m^2 \end{array}$$

Division of polynomials is next on the program. As a starter, let us center our attention first upon division of a polynomial by a monomial. *Divide each term in the polynomial by the monomial, and add the individual quotients with due regard to sign.*

Find the quotient of

$$\frac{4x^3+6x^2+8x^4}{2x}$$

$$\frac{4x^3+6x^2+8x^4}{2x}=\frac{4x^3}{2x}+\frac{6x^2}{2x}+\frac{8x^4}{2x}$$
$$=2x^2+3x+4x^3$$

Hence we split a problem of this type up into several divisions, each of which is a monomial divided by a monomial, and in that form the problem is easily handled.

The permissibility of changing the form as we have done above is easily justified by a numerical example, thus:

$$\frac{4+2+6}{2}=\frac{12}{2}=6$$

$$\frac{4}{2}+\frac{2}{2}+\frac{6}{2}=2+1+3=6$$

Here's another example for this method:

$$\frac{6m^2x^4-8mx^3+4m^2x^2}{2mx}=$$
$$\frac{6m^2x^4}{2mx}-\frac{8mx^3}{2mx}+\frac{4m^2x^2}{2mx}=$$
$$3mx^3-4x^2+2mx$$

The next step forward is consideration of division of a polynomial by a polynomial. We will use as an illustrative problem:

$$7xy+3y^2+2x^2\div y+2x$$

First we rearrange the dividend and divisor so that they are in ascending or descending powers of some letter which exists in both. When we rearrange a poly-

nomial in *ascending* powers of some letter, say x, we mean that the terms are re-grouped so that the term containing the lowest power of x is written first, the term containing the next larger power of x is written following, and so on. When we rearrange a polynomial in *descending* powers of some letter, say x, we mean that the terms are re-grouped so that the term containing the largest power of x is written first, the term containing the next smaller power of x is written following, and so on.

Hence, our dividend in *descending* powers of x is:

$$2x^2+7xy+3y^2$$

And our divisor in *descending* powers of x is:

$$2x+y$$

Place the rearranged dividend and divisor in the form used in arithmetical long division:

$$2x+y \,\overline{)\,2x^2+7xy+3y^2}$$

Divide the first term in the dividend (i.e., $2x^2$) by the first term in the divisor, (i.e., $2x$). Write the result as the first term in the quotient:

$$\begin{array}{r l} & x \\ 2x+y & \overline{)\,2x^2+7xy+3y^2} \end{array}$$

Multiply all terms of the divisor by the first term in the quotient:

$$\begin{array}{r l} & x \\ 2x+y & \overline{)\,2x^2+7xy+3y^2} \\ & \underline{2x^2+\ xy} \end{array}$$

Subtract the product:

$$\begin{array}{r l} & x \\ 2x+y & \overline{)\,2x^2+7xy+3y^2} \\ & \underline{2x^2+\ xy} \\ & \qquad 6xy \end{array}$$

Form a new dividend with the remainder:

$$\begin{array}{r l} & x \\ 2x+y & \overline{)\,2x^2+7xy+3y^2} \\ & \underline{2x^2+\ xy} \\ & \qquad 6xy+3y^2 \end{array}$$

Proceed as before, that is, divide the first term in the new dividend (i.e., $6xy$) by the first term in the divisor, and place the result in the quotient. The result is then the second term in the quotient. Multiply all terms of the divisor by this second term in the quotient:

$$\begin{array}{r l} & x+3y \\ 2x+y & \overline{)\,2x^2+7xy+3y^2} \\ & \underline{2x^2+\ xy} \\ & \qquad 6xy+3y^2 \\ & \qquad 6xy+3y^2 \end{array}$$

We chose the dividend and divisor in the foregoing problem so that the dividend was exactly divisible by the divisor. That is, there was no final remainder. Appended is another case wherein exact division is not possible. The quotient in this instance turns out to be a polynomial and a polynomial fraction:

$$\begin{array}{r l} & 2k+4s \\ 4k+s & \overline{)\,8k^2+20ks+14s^2} \\ & \underline{8k^2+\ 2ks} \\ & \qquad 18ks+14s^2 \\ & \qquad \underline{16ks+\ 4s^2} \\ & \qquad\quad 2ks+10s^2 \end{array}$$

$$\therefore \text{Quotient}=2k+4s+\frac{2ks+10s^2}{4k+s}$$

The above example is similar to an arithmetical problem in long division wherein exact division is not possible, like this:

$$\begin{array}{r l} & 22 \\ 43 & \overline{)\,973} \\ & \underline{86} \\ & 113 \\ & \underline{\ 86} \\ & \ 27 \end{array}$$

$$\therefore \text{Quotient}=22+\frac{27}{43},\ \text{or, simply, } 22\frac{27}{43}$$

We take leave of division to center our attention on the next topic, *factors*. We found in Section I of this series that when a product is formed by multiplying together individual numbers, the individual numbers are factors of the product, and further, that multiplied combinations of the individual numbers are factors of the product. That preliminary discussion, however, was confined to monomials. It was shown, as an example, that the factors of the monomial $5cd$ are 5, c, d, $5c$, cd, $5d$. Polynomials may also be factored, in some instances. Factoring is often useful when dealing with polynomial fractional expressions such as

$$\frac{5c-5d}{5x-5y}$$

for through factoring such expressions may be simplified. The factor common to the numerator and the denominator of a fraction such as we use for illustration may be found, then cancelled above and below, thereby finally producing a simpler expression.

From inspection we can factor $5c-5d$ thus:

$$5c-5d=5(c-d)$$

From inspection we can factor $5x-5y$ thus:

$$5x-5y=5(x-y)$$

Therefore:

$$\frac{5c-5d}{5x-5y}=\frac{5(c-d)}{5(x-y)}=\frac{c-d}{x-y}$$

In some examples of this nature factoring so simplifies the expression that the denominator becomes simply unity, and thus need not be written in the simplified expression. For example, factor and simplify:

$$\frac{4y^2+8y+10zy}{2y}$$

From inspection it is found that each term in the numerator is evenly divisible by $2y$. Hence $2y$ is a factor of the numerator. Therefore:

$$\frac{4y^2+8y+10zy}{2y}=\frac{2y(2y+4+5z)}{2y}=2y+4+5z$$

Sometimes proper re-grouping of the terms in a polynomial will help in the factoring. Take, for instance, the polynomial expression:

$$am+bn+an+bm$$

Re-group this expression so that all the terms containing a are in one group, and all the terms containing b are in one group.

$$am+bn+an+bm=$$
$$(am+an)+(bm+bn)$$

In the first group, a can be placed outside the parenthesis as a factor; in the second group, b can be placed outside the parenthesis as a factor:

$$am+bn+an+bm=$$
$$a(m+n)+b(m+n)$$

It is seen that the polynomial $(m+n)$ is common to both groups in their new form above. The polynomial $(m+n)$ is, therefore, a common factor of the groups, and when we factor out $(m+n)$ from the

Clinical Note For Theatre Managers

"Even under adequate lighting and with normal vision, it has been estimated that there is a consumption of a quarter of the bodily energy in the process of seeing. When vision is normal, the ease of seeing is controlled almost entirely by sufficient and proper lighting. However, when the illumination is improper or inadequate, and when the vision is poor, then consumption of bodily energy is increased above the usual amount."

Dr. Charles Sheard, The Mayo Foundation

groups we get the following expression:

$$am+bn+an+bm=(m+n)(a+b)$$

Thus our factors of $am+bn+an+bm$ are $(m+n)$ and $(a+b)$, for if these polynomials are multiplied together the product will be the original expression, $am+bn+an+bm$. The entire procedure for this example just completed may be clarified if we substitute numbers for the symbols. In

$$am+bn+an+bm$$

substitute $a=2$, $b=3$, $m=4$, $n=5$

$$2\times4+3\times5+2\times5+3\times4=$$
$$(2\times4+2\times5)+(3\times4+3\times5)=$$
$$2(4+5)+3(4+5)=$$
$$(4+5)(2+3)=(9)(5)=45$$

Often polynomials can be immediately resolved into factors through recognition of the polynomial as a power or a product of lesser polynomials.

Since $a+b^2=a^2+2ab+b^2$, the factors of $a^2+2ab+b^2$ are $(a+b)$ and $(a+b)$.

Since $(a-b)^2=a^2-2ab+b^2$, the factors of $a^2-2ab+b^2$ are $(a-b)$ and $(a-b)$.

Since $(a+b)(a-b)=a^2-b^2$, the factors of a^2-b^2 are $(a+b)$ and $(a-b)$.

In consequence, if we have a fraction such as

$$\frac{a^2+2ab+b^2}{a^2-b^2}$$

which at first glance looks a little involved, through factoring we can readily boil it down to a very simple expression:

$$\frac{a^2+2ab+b^2}{a^2-b^2}=\frac{(a+b)^2}{(a+b)(a-b)}=$$

$$\frac{(a+b)(a+b)}{(a+b)(a-b)}=\frac{a+b}{a-b}$$

Ratio and *proportion* are the final items to study in this section of the series.

When we seek the relative magnitude of a number x compared with a number y, we divide x by y. In other words, when we desire the *ratio* of x to y, we indicate the operation to be performed in any one of the following equivalent forms:

$$\frac{x}{y} \qquad x/y \qquad x \div y \qquad x:y$$

The last form is frequently used when we are thinking particularly of a ratio rather than of a mere division. Personally I prefer writing the ratio of x to y as simply $\frac{x}{y}$, for it tells the story, and avoids introduction of a more or less superfluous member to our family of operational symbols.

What is the width ratio of 35 mm film to 16 mm film?

$$\text{Width ratio}=\frac{35}{16}=2.18 \text{ approx.}$$

In this example the ratio is *approximate* because 35 is not exactly divisible by 16. But the more decimal places found for the ratio, the more accurate is the ratio. And any degree of accuracy is obtainable by simply carrying the division far enough.

When we speak of the ratio of two magnitudes it is obvious that the magnitudes under consideration must be the same kind of thing. It would be an absurdity, of course, to seek the ratio of the number of feet of film on a reel to the seating capacity of a theatre. But it conceivably could be useful, however, to know the ratio of the footage on one reel to the footage on another reel, for that ratio would give us an idea of the relative running time of the respective reels.

Certain things about ratios are useful to know.

The value of a ratio is not changed if both terms are multiplied by the same number, for:

$$\frac{a}{b}=\frac{na}{nb}$$

The value of a ratio is not changed if both terms are divided by the same number, for:

$$\frac{a}{b}=\frac{\frac{a}{n}}{\frac{b}{n}}=\frac{na}{nb}$$

A given number cannot be added to or subtracted from the terms of a ratio and keep the ratio value unchanged.

$$\frac{a}{b}\neq\frac{a+n}{b+n}$$

$$\frac{a}{b}\neq\frac{a-n}{b-n}$$

Ratios are used in forming *proportions.* An equation comprised of two equivalent ratios is called a proportion. Thus the equation

$$\frac{a}{b}=\frac{c}{d}$$

is a proportion. It is read: a is to b as c is to d.

In this general expression for a proportion the terms b and c are called *means*, and the terms a and d are called *extremes.* Various useful things to know about proportion are stated and proven below.

If two ratios form a proportion, the product of the means is equal to the product of the extremes.

Given:

$$\frac{a}{b}=\frac{c}{d}$$

Cross-multiply to clear of denominators:

$$da=cb$$

If the product of two numbers is equal to the product of two other numbers, a proportion can be formed of the numbers by setting one pair as means, the other pair as extremes.

Given:

$$da=cb$$

This is the same as:

$$\frac{da}{1}=\frac{cb}{1}$$

Cross multiply:

$$\frac{a}{1}=\frac{cb}{d}=\frac{a}{b}=\frac{c}{d}$$

If two ratios form a proportion, the terms inverted are also in proportion.

Given:

$$\frac{a}{b}=\frac{c}{d}=1\div\frac{a}{b}=1\div\frac{c}{d}$$

$$\frac{1}{\frac{a}{b}}=\frac{1}{\frac{c}{d}}=\frac{b}{a}=\frac{d}{c}$$

If all terms of a proportion are raised to a given power, the terms still are in proportion.

Given:

$$\frac{a}{b}=\frac{c}{d}$$

$$\left(\frac{a}{b}\right)^n=\left(\frac{c}{d}\right)^n=\frac{a^n}{b^n}=\frac{c^n}{d^n}$$

Here's a practical problem to wind up this section. If it requires 10 minutes to run 900 feet of film through a projector, find by proportion the time required, t, to run 720 feet. By proportion, 900 is to 720 as 10 is to t:

$$\frac{900}{720}=\frac{10}{t}$$

Solving for t:

$$\frac{(900)(t)}{720}=10$$

$$t=\frac{(10)(720)}{900}=8 \text{ minutes.}$$

(TO BE CONTINUED)

The H-S All-Metal Arc Reflector

By *C. E. SHULTZ*

HEYER-SHULTZ, Inc.

The utilization of all-metal reflector mirrors for motion picture projection work has long been the goal of several earnest experimenters, and the topic of much discussion among projectionists. Current extensive promotional work in behalf of this type of mirror in the theatre field warrants the attention of projectionists to the end that they may be familiar with the characteristics of this new projection adjunct.

PROBABLY the foremost thought in the minds of projectionists using metal reflectors is the inherent element of rugged dependability so evident in a piece of solid metal, from which this type of unit is fabricated. While this is an indisputable advantage, it is only one of the many basic potentialities of a unit constructed expressly for use in high-intensity projection where extreme temperature must be contended with constantly.

The three outstanding reasons for rapidly increasing use of metal reflectors are that they are unbreakable, and are not subject to pitting and tarnishing. These advantages not only lead to definite economy but assure continuous maximum performance. Resistance to tarnishing and pitting is accomplished by the utilization of a metal known as rhodium possessing characteristics which make it exceptionally suitable for use in projection mirrors. The unique metal has a melting point of about 3,600° F, or almost 1,000° above the melting point of steel. In solid form it is insoluble in any single acid, thus giving it immunity to tarnishing.

● Efficiency, Ease of Cleaning

The hardness of this metal is important as it determines resistance to scratching. It is of interest to note that rhodium has a Rockwell hardness of 90 as compared with that of tool steel at 60. The question of scratching is of paramount importance to projectionists, as carbon particles and other foreign matter are sure to work into the cleaning process of any projection reflector. Representative tests have been made to determine the percentage of loss suffered in this manner. A new metal reflector was given a photometric recording through a standard projection system, removed and scoured with sand until the entire surface was covered with scratches. This extreme test produced a loss of reflectivity of only 4 per cent, which leads to the conclusion that average scratching, even over an extended period of years from normal cleaning, would result in a negligible light loss.

The projectionist will welcome the fact that these new mirrors may be cleaned while hot with a wet cloth without damaging them in any way, and, if he so desires, he may remove the reflector and douse it in cold water without damaging its curve or its shape. As no accumulations of particles from the arc occur, these reflectors may be cleaned easily at any time during their life. No special and expensive cleaners are needed for this operation, as powdered Bon Ami, an excellent agent for the purpose, is supplied free of charge by the manufacturer.

These reflectors, unlike some previous metal mirrors, need never be returned to the factory for repolishing, the finish being permanent. Exhaustive tests have been conducted on these units with high-intensity arc sources for the past five years, the present units having been designed on the findings of this extensive research, which has been based largely on the suggestions and criticisms of the projectionists in whose hands these mirrors have been placed.

● Reflectivity, Color Response

An interesting fact concerning mirrors of this design is their ability to retain heat. After being heated by the first few minutes of projection they will hold their temperature throughout the day, thus minimizing expansion and contraction. No change in curve or focus occurs, even when utilized with the most powerful type arcs operating at extreme angles of projection, the heat flowing evenly through the highly conductive metal of which they are composed.

The reflectivity of rhodium has been placed at 77 per cent by reliable sources, and the spectral response characteristic of this metal represents excellent fidelity throughout the visible spectrum. This fact alone, however, does not tend to produce a color-free system which will faithfully reproduce the snow-white characteristics of the crater of simplified high-intensity type carbons. The final step is accomplished through precision of curvature, any deviation from which results in the majority of unwanted color.

Relative to the correction of curve, three important factors warrant consideration: (a) color rendition (b) working range and (c) distribution. Foreign color differing from that of the crater appears in the following manner: let us suppose we are imaging the crater of a simplified high-intensity type source, as shown in Fig. 1, in which the colors of the arc are divided into three zones marked *C*, *A* and *B*. The first section *C* represents the discharged gases of blue and purple color. Section *A* represents the snow-white area formed in and directly adjacent to the crater floor of the arc. Section *B* represents an area formed by the glowing carbon surrounding the crater which is yellowish in color.

To produce a snow-white image focusing of zone *A* must be accomplished individually without including zones *B* and *C* and their undesirable color characteristics. This condition of separation of the zones can only be accomplished by the utilization of a highly accurate ellipsoidal curvature as nearly free from spherical aberration as possible, which must be a first-surface mirror of a material of undistorted spectral response.

Figure 2 represents resulting color imaging due to incorrection of curvature from spherical aberration. *E* represents incorrection of curve in which the reflecting surface is shown forward of the true ellipsoidal curve; while *F*

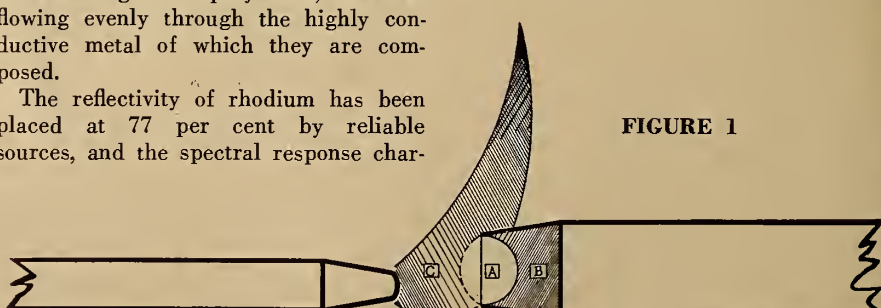


FIGURE 1

represents a reverse condition, the reflecting surface being behind the true ellipsoidal at this point.

Following the incident light reflected from the white section of the arc, we

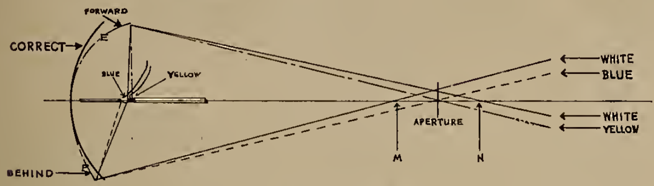


FIGURE 2

find that in case E the white light does not come to conjugate focus at the aperture but crosses the axis somewhat further on (N in Fig. 2); and in case F the reverse holds true as the conjugate focus from the white section occurs on the axis before reaching the aperture (M in Fig. 2).

Let us suppose that this incorrection produced a condition that would cause (in E) an imaging at conjugate focus of the yellow area shown in Fig. 1, and that in like manner (at F) the blue area would also be focused at the aperture but the white section would not individually cross the axis at the aperture. In this way either of the undesirable colors might be focused individually or both might fall at conjugate focus at the same point producing blue or yellow or a mixture, resulting in a greenish tint.

As all pencils of incident light from a corrected curve fall at conjugate focus at one position on the axis, as shown in Fig. 3, the color zones on either side of the white section A fall at conjugate focus at relative points on the axis behind and in front of the aperture, thus producing accurate imaging of section A individually, so desirable in obtaining white light.

● Individual Equipment Test

As the new H-S metal mirrors are corrected for this condition, they are particularly suited for the projection of color motion pictures, in which snow-white illumination is an absolute necessity if maximum results are to be obtained. Black-and-white projection is also improved in depth as well as definition, as a crispness of high lights, through added contrast, becomes evident.

The projectionist will find it possible to produce improved results as the range of focal change is greatly increased, that is, the positive carbon may "wander" ahead or behind its setting to a much greater distance before the screen image becomes yellow or blue. So that the projectionist may conduct an accurate test on his own equipment, the following method is suggested:

Punch a pin-hole in a piece of thin metal in such a manner that it may be placed over the aperture with the hole exactly centered. Operate the projector without film, and with a piece of cardboard find the position in front of the objective lens where an image of the reflector will appear in focus—this is, such as point Y shown in Fig. 4, representing image formation. (X represents the aperture position.)

When the correct focus is located a H-S metal reflector will produce a clear white disc of light at point Y. If the focal distance be lengthened, areas of blue and purple will appear, and by shortening the focal distance, yellow and brown areas will be noted. Uncorrected reflectors produce color at all settings and it is impossible to obtain a clear white disc.

This simple test may also be utilized in setting up indicator cards accurately or being certain of perfect focus when inserting a new reflector.

It is evident from this test that an uncorrected reflector which is never free from color has no range, as the slightest focal change will immediately amplify either the blue into purple or the yellow into brown; while the corrected unit producing a clear white disc must move some distance before any color will appear, and still further before the deeper hues are evident.

Distribution of screen illumination is improved through corrected curve, as spherical aberration is reduced bringing all parts of the reflecting surface to focus at a single point. Poor distribution may be brought about by: (1) unmatched reflector and lens speed (2) misalignment and (3) improper working distance. An uncorrected mirror is always at an improper working distance at some part of its curve, usually at the outer part, as this is the most difficult to make accurate.

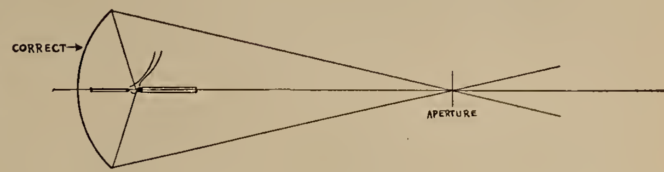


FIGURE 3

For example, let us suppose that in testing as described, we find that an uncorrected mirror produces a ring of purple and blue around the outer portion when focused to an optimum setting. We know that this color denotes a long focal length, although the rest of the mirror is functioning properly.

As every part of an ellipsoidal curve will throw a complete "spot," we know that the complete image of the crater thrown on the aperture is composed of an infinite number of superimposed "spots" each one progressively smaller as reflected respectively from center to outer parts of an ellipsoid, thus the outer areas form the smallest of these discs and produce the bright center of the screen image. If the test shows these areas to be long in focus, they are then producing even smaller discs and brighter central zones.

In a corrected reflector the smallest disc is ample in size to cover the aperture, and all other superimposed discs focused at the same point form a solid area of well-distributed light at the conjugate focus.

The correction of H-S metal mirrors also assures very close standardization in focus and efficiency, making possible their use interchangeably.

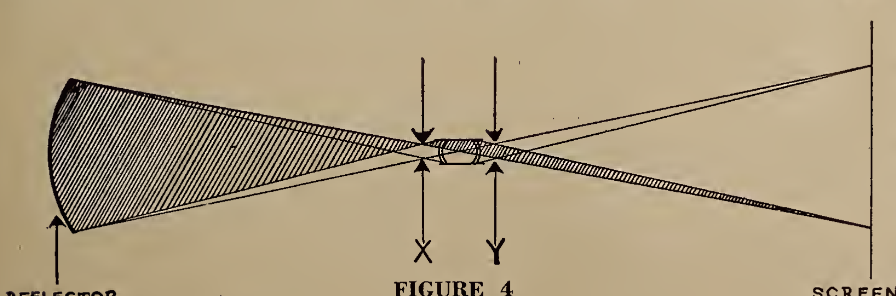


FIGURE 4

'LENS APERTURE' TERM

The "f" number engraved upon the lens mount simply indicates the relationship between the focal length of the lens and the diameter of the largest stop. For example, "$f/2$" with a lens of 2-inch focal length will indicate an effective aperture of 1 inch. Light loss through reflection within the lens is not taken into account in this calculation.

In every optical combination light loss appears, owing to reflection from each glass to air surface. The smaller the number of glass-to-air surfaces the lens has, the greater is the freedom from reflection and consequent light losses.

Process Projection Specifications

A REPORT BY THE RESEARCH COUNCIL, ACADEMY OF M. P. ARTS & SCIENCES

VII. FILM GATE AND PROJECTOR HEAD

Normal-Speed Head

APERTURE (Basic):

The projector head shall be so designed that an F1.6 cone of light can be accommodated through the aperture and fill an F1.6 projection lens from all parts of the picture, necessitating that the opening behind the aperture be of sufficient angle to allow the above cones of light to reach all parts of the aperture. The projector head should be designed to accommodate F1.6 lenses (when such fast lenses are satisfactorily developed) and permit lenses of large diameter* to come close enough to the aperture and not interfere with the operation or steadiness of the movement to obtain a proper focus on any length of set-up. A full screen aperture, 0.950″ by 0.723″, shall be provided.

SHUTTER OPENING (Basic):

The projector head should be designed for a maximum shutter opening of 240°, this to mean that the film shall be at rest and the shutter to fully clear the aperture for this period of time.†

SYNCHRONIZING (Basic):

A readily accessible synchronizing device which is quick and positive in operation shall be incorporated in this design. This device shall synchronize the projector and camera shutters to a tolerance of ±2°.

MOTOR DRIVE SYSTEMS (Basic):

Provision shall be made in the design of the projector head motor drive so that the projector can be inter-locked with the camera and recorder motor drive system, and so that it will maintain the tolerances as given above under the basic recommendation "Synchronizing".

COOLING DEVICE (Basic):

A cooling device shall be provided in the optical system or incorporated in the aperture design. It has been suggested that a stream of air striking the film from the projection lens side and away from the light source, be employed. Such a device, if within the specifications given under "Noise Level," would also help to meet the recommendations given under "Position of the Film During Exposure," as a means of holding the film in the aperture during exposure.

For the mirror or straight condenser type of lamphouse, the design shall also include a means, located between the gate and light source, to eliminate from the film aperture assembly that portion of spill light not actually used in the aperture. This device should be interchangeable to accept an F1.6 to F2.3 cone of light. The development of such means or device is recommended primarily to decrease the amount of heat on the film trap assembly with no loss of light in an F1.6 system.

In the relay system such a device may not be necessary as the amount of spilled light is practically nil. However, provision should be made for such a device should it be found necessary.

*NOTE: See "Standards of Lens Mount Diameters".

†NOTE: It is understood that all equipments shall be equipped with rear shutters. It has been further suggested that a 240° shutter be developed for the camera.

REGISTRATION AND REGISTERING PINS (Basic):

Inasmuch as steadiness of picture is the *basic and primary requisite* of a background projector equipment, the design shall be such as to include pilot pins providing rock-steady registration. These pilot pins may be either moving or stationary, providing the above specified registration is obtained and the pins stand up reasonably well under projection conditions.*

ADJUSTMENT CONTROL OF REGISTRATION (Basic):

Adjustment control means shall be provided in registration to accommodate a maximum film shrinkage of 0.030″ per foot, this adjustment to be calibrated against the vertical adjustment of the aperture.

REGISTRATION — FILM REVERSED (Accessory):

If possible, means should be provided to reverse the registering pilot pins to give good registration to a background print when it is necessary to turn the background print over for projection purposes.

CLEARANCE (Basic):

Sufficient clearance, that is, space between the aperture and lens, shall be left in the design to accommodate a projector head giving the steadiness required in the above specifications. (See "Aperture".)

*NOTE: The pilot pins of the projector should engage the same perforations as the camera and printer.

Classifications in Report

In order to clearly specify the relative importance of the various recommendations included in the report, each subheading in each part is indicated by one of the three following classifications:

BASIC—Recommendations so indicated incorporate definite requirements and principles. (Printed in bold face type.)

AUXILIARY — Recommendations so indicated are suggested methods of meeting basic requirements. (Printed in light face type.)

ACCESSORY—Indicates optional special refinements which add to the ease of operation of equipment. (Printed in italic type.)

FORWARD AND BACKWARD OPERATION OF HEAD (TWO-DIRECTIONAL MOVEMENT (Basic):

The projector head shall be so designed as to have the ability to run either forward or backward with perfect registration with a take-up designed to take care of this two-way operation. This should be accomplished with no damage to the film as specified under "Operating Speed of Head". This type of two-directional projector head also fulfills the function of projecting a back-cranked scene with the camera running forward and the projector running backward, both shutters operating in synchronism.

This recommendation is made after consideration of observations and comments made by those members of the Committee who have worked with this type of equipment. The resultant saving of production time will far more than offset any added difficulties encountered in securing such design.

(Accessory): It has been suggested that the design of the two directional movement be such that the background print can be rewound without taking the film from the projector head, by disengaging the synchronous motor from the distributor and operating independently.

POSITION OF FILM DURING EXPOSURE (Auxiliary):

A method is desired in the design which will aid in holding the film as near as possible in the same exact plane during each exposure period under any heating or operating condition. (See "Cooling Device.")

ROTATION OF HEAD (Accessory):

The projector head should be so designed as to rate 90° either to the right or left about the optical axis, making a total circular coverage of 180°

(Accessory): It has been suggested that for the purposes of rigidity and registration in the equipment an attachment or device be designed to rotate the projected image 90° to the right or to the left, making a total circular coverage of 180°, rather than rotate the projector head. This might be accomplished through the use of prisms, first surface mirrors, or adaptor plates used in conjunction with a separate head.

FOCUSING CONTROL (Basic):

The design shall include a remote control for focusing, operating from the camera position.

(Auxiliary): It has been suggested that the above focusing control be provided with a rheostat and be operated by a

(Continued on page 23)

Industry Ills Many and Serious

By *JAMES J. FINN*

IT SEEMS pertinent at this time to consider the turn of events within the motion picture industry which, although non-technical in character, are of such importance as to relegate television to the level of a minor industry worry (only a few weeks ago television jitters were very conspicuous on all sides) and affect profoundly the welfare of everybody engaged in motion picture work—including projectionists.

The industry's cup of woe apparently was filled to the brim what with a run of poor product and consequently sharply reduced theatre takes, estimated to approximate 40 per cent in a majority of situations; with Hollywood sticking pigheadedly to fantastic picture budgets for product most of which couldn't and didn't draw flies to theatre box-offices, and with Uncle Sam's anti-trust suit against every major industry rocking the industry to its already well-rounded heels. But this was as nothing compared with what was in store for this madcap merchandiser of glamour, as witness the following developments:

● List of Stupidities

1. Passage in the House of Representatives of the Neely Bill (with favorable Senate action forecast), providing for the elimination of block booking and the institution of various other "ethical" and "equitable" trade practices designed to prevent the elimination of the independent exhibitor.

2. Launching by the Department of Justice of a "sweeping" investigation on the West Coast of various alleged tax-dodging by industry executives and by picture corporations, and of labor relations between producers and workers.

3. Point-blank pronouncement by the Dept. of Justice that the "code of fair practices" so painstakingly contrived by distributors to keep the independent exhibitors quiet for a few more years was wholly unsatisfactory in that it sought to perpetuate in a slightly different form the very "evils" that the Federal Government was bent on eliminating. Not only would this "subterfuge" not occasion withdrawal of the pending anti-trust suits, said the Attorney General for the bewhiskered fellow, but it compelled a demand for the *divorcement* of circuit theatres from parent producer-distributor companies.

4. The C. I. O. and A. F. of L. West Coast unions tangled; and although the AFL-affiliated I. A. Locals snagged a five-year contract from the producers, the agreement explicitly excluded a closed shop and recognized the validity of existing contracts between the producers and other labor groups. The C. I. O., of course, yelled "cop" and dragged into the situation the N. L. R. B.—which four letters are regarded by A. F. of L. units as spelling p-o-i-s-o-n.

5. The I. A.-4 A's brawl anent jurisdiction over all performers was aired before the A. F. of L. Executive Council with attendant publicity, mostly on the actors' side, that would murder any other industry. The fight was "settled" once only to be "unsettled" by a quarrel concerning the immediate future of a heretofore comparatively inconspicuous minor official of the 4-A's upon whose status apparently hinges the employment of more than 150,000 people and the security of billions of dollars worth of investment.

6. The tenacity with which the bonus boys in producer-distributor ranks in Hollywood and on Broadway cling to the ticker tape announcing the returns from, or the avidity with which they burn up the roads leading to, various race tracks dotting the verdant terrain of these assumedly United States.

7. The threat of television to theatre box-offices.

Thus the outline of the wholly untenable position into which the motion picture industry has jockeyed itself. No branch of the business can honestly claim exemption on the basis of not having contributed to the mess. We almost forget to include in the list No. 7, relating to television, although this is the only problem that makes sense. The distributor-exhibitor controversy may be cited by some as a "tough problem" that has withstood solution by some of the industry's "best minds" for many years. The fact that this "problem" has attained such longevity attests eloquently to the utter lack of innate honesty that has characterized the actions of representatives of both groups.

The labor fusses aforementioned are reported upon in detail elsewhere in this issue, thus they are skipped over in this space. Let's make a hasty appraisal of the other "serious problems."

● Neely Bill a Bust

First the Neely Bill. It is years since the writer messed much with producers, distributors, exhibitors or their self-appointed (usually) "protectors," but in the absence of any visible change in the setup he assumes that the same rules of

Projectionist Day at N. Y. World's Fair, Sept. 7

EVERYTHING is in readiness for Projectionist Day at the New York World's Fair on Sept. 7, according to P. A. McGuire, of the International Projector Corp., who is coordinating the activities of a group of Metropolitan N. Y. projection men who are bending every effort to make the affair truly representative of the craft.

Scores of Eastern Local Unions have already named their representatives for the event, as was expected, but the real surprise is the gratifying response received from Locals far distant from New York. Typical of this response is the action of Miami Local 316 which not only "endorses the event 100%" but will be represented thereat by several of its members. Lou Kaufman, b. a. of Newark Local 244 is chairman of the I. A. Locals Committee.

Speeches will be brief, being limited to five minutes each. Among those who have already accepted invitations to address the gathering are President George E. Browne of the I. A.; Mayor Fiorello La Guardia of N. Y. City; Nat Golden of the U. S. Dept. of Commerce; E. A. Williford, president of the S.M.P.E.; Earl Hines, president of International Projector Corp., and Dr. A. N. Goldsmith, consulting engineer and former president of the S.M.P.E. Both RCA and Altec Service Corp. are tendering their services.

Prominent among those in charge of arrangements are Harry Rubin, director of projection for Paramount Pictures; Lester Isaac, director of projection for Loew's Theatres, and his associate, M. D. O'Brien; Joe Basson, president of Local 306; Thad Barrows and Jimmy Burke of Local 182, Boston; Victor Welman of Cleveland Local 160; Arthur Martens and Dick Hayes of Local 650, Westchester County, and Frank Cummings of Long Island Local 640. Further information relative to the affair may be had from either P. A. McGuire or J. J. Finn.

the game apply. It required only one reading of the Neely measure, however, to reach the conclusion that exhibitors are chumps if they go for it.

So, Mr. Independent Exhibitor wants block-booking abolished, does he, and the practice of individual buying *and selling* substituted therefor? He also wants the prospectus of a given picture to reflect hairline accuracy? He also wants "liberal" cancellation privileges for cause? Shades of David Harum, but he'll get them!

Even a neophyte in the business must realize the utter absurdity of merchandising film on an individual-picture basis. Joe Glutz of Toledo, for example, will be so harassed by worry anent a supply of product that he'll get down on his knees and beg the salesman to "sell me just one more." Certainly Joe Glutz will enjoy (?) the right to buy; but Mr. Distributor still will enjoy the more advantageous right to sell—and at almost any figure he elects. Existing abuses incident to block-booking will be as so much trivia by comparison with happenings under the individual-picture sales plan. The mere right of Joe Glutz to buy pictures will not miraculously expand his bankroll to a point where he can outbid his circuit theatre competitor, which need only bid $2.50 more than Joe on any release. Of course, the widely prevalent overbuying evil will be eliminated.

The Neely Bill will provide Mr. Distributor with his greatest opportunity since the filming of "The Great Train Robbery" to get top prices for product. It will be a shambles in which innumerable Joe Glutzs will be slaughtered. Nowhere in the reams of comment anent the Neely Bill did we find even a passing reference to the dangerous precedent set by the passage of this measure in declaring open season on legislation against the movies, long the target of every reform group and legislative body from Augusta to Zanzibar.

Tax-dodging by ranking producers and by major film corporations, together with some queer twists in employer-labor relations, if proven, will constitute a fitting companion-piece to that other engaging canvas exposed to public view in the form of petty-larceny smuggling by some top talent names who are earning a paltry $2000 weekly. Great stuff, this, for bluenoses and legislators.

The recently promulgated code of fair practices designed to clean up existing evils in the distributing field was, of course, a joke from its inception—apart from a worthy cancellation insert. Uncle Sam, in rejecting this code, demands the outright divestment by producers and distributors of all exhibition holdings. This governmental ukase occasions one of the biggest laughs since the Standard Oil Company was dissolved—only to be reorganized on a sectional basis that made Standard even bigger pumpkins than before.

Somebody should ask the Det. of Justice just what is to become of these producer affiliated theatres. For example, shall we just uproot the Loew houses and dump them into the ocean? If not, where is there to be found a purchaser with sufficient capital to lay it on the line to the Loew people? Naturally, a prospective purchaser could go to the banks and float a loan—but this would be hedged about with the usual restrictions, and control would probably reside for many years to come in the hands of those who through financing picture companies, including Loew, may be said to control production. So what? It would be just another Standard Oil deal—merely a question of right- and left-hand pockets.

● Bonus Boys at Play

The passionate devotion of Hollywood and Broadway motion picture people to racing is so well known as to provide the basis for many a *mot.* Executives, players, directors, technicians—the whole picture mob—devotes practically three months each year to following the bangtails at their favorite California tracks—race meetings which deplete the studio personnel and occasion wonder that any work is done. Leading film executives own tracks and horses, and their business pals grace the boards of directors; ditto with some leading players. When the California tracks are closed, the picture mob still manifests considerably more interest in the consensus of opinion on the fifth at Hialeah, Arlington, Havre de Grace and other tracks than they ever do about the quality of pictures. Santa Anita, the Mecca for the Hollywood mob, now being closed, the exhibition field may expect a sharp upturn in picture quality soon.

Just a few notes on television. Sales of television receivers during the last three months in the New York City area approximate 300, very few of which were bought on the time-payment plan. This means that most purchasers are in the top-income brackets. The N.B.C. tele programs thrice weekly are estimated to have an audience of 5000. Five N. Y. City theatres have installed tele receivers in their lobbies—but it is generally conceded that tele is a flop as an attention-getter. N. B. C. estimates that 1940 will see a total Metropolitan N. Y. audience for television of 100,000.

General Electric announced recently that means for extending the present 50-mile transmiting range of tele images were available; but with the chips down at an exposition G. E. failed to make good on this.

Bell Telephone Laboratories crowed about the successful transmission of television images over a telephone line from Madison Square Garden to the N. B. C. studios in N. Y. City, a distance of one mile. Payoff on this stunt is that such transmission is possible for short runs, provided that special equalizers are used at exchanges and at terminals, plus a special amplifier. Experts aver that

images so transmitted are only 30% as good as conventional tele pictures.

● Home Shows Impress

The writer sat in on two home demonstrations of television, each program of approximately 1½ hours duration. Seven people viewed the images very comfortably without straining, and there was ample lighting on the screen. Variety programs are the most popular; but a broadcast of a melodrama proved so engrossing that two spectator-auditors had difficulty in restraining their emotions—a very significant angle from the standpoint of showbusiness.

Receiver circuits use from 18 to 36 tubes, in addition to the expensive "eye" tube. Current retail prices on the latter are: for a 5-inch tube presenting a black-and-white image, $27.50; for a green-tinted picture, $25; for a 9-inch tube, $60; for a 12-inch tube, $75. Life of these tubes is estimated to be 1000 hours. Their cost is expected to be halved when television really gets rolling.

Attitude of the motion picture industry toward television has some interesting angles. Picture people refuse flatly to cooperate with the tele crowd, reason advanced being that it would spur "unfair competition" to film theatres. Result is that tele people have some difficulty in obtaining suitable film program fare, bulk of current stuff being independent cartoon releases and foreign films. Still, it is significant that around the N. B. C. tele studios one never hears any expression of concern about film supply, the assumption being that whenever films are needed the tele people will go right out and make them. Where this will leave the film producers is anybody's guess. Incidentally, several film moguls have announced a firm determination to keep their stars off tele programs; this while the radio airwaves currently are cluttered up with the outgivings of dozens of America's most prominent players.

● Baird Theatre Television

Most recent big noise in television circles, from the showbusiness standpoint, was the series of big-screen television demonstrations given in N. Y. City by the Baird Television Co., which has long been active in England. Equipment installed in a N. Y. studio (which picks up images broadcast by N. B. C. and then blows them up on a picture sheet) is capable of projecting an image 20 by 15 feet, but studio limitations forced a cut to the 9 x 12 foot size. Details of this equipment were published in I.P. last month, p. 21.

The non-technical boys from the industry trade press went into raptures about this demonstration, giving out with such statements as that the 9 by 12 foot images approximated the quality of mo-

tion pictures of eight years ago, and numerous other effusions. For the benefit of I. P. readers it can be said that this is the veriest bunk, the Baird tele images, while not too inferior considering the state of the television art and the fact that the images were blown up, being not too inferior but approximating rather the quality of motion pictures twenty years ago. The lighting was decidedly inferior; but Baird can blame the N. B. C. studio for this; and definition was conspicuously absent. A start, yes, but nothing to write home about.

Meanwhile reports from England indicate that the enthusiasm generated some months ago by the televising of a couple sporting events and the coronation, which were fed into several theatres before overflow crowds, has diminished noticeably. "The novelty of television has passed," said one prominent British film exhibitor recently. Set sales for home use have slumped badly in England during the past two months, and one hears very little these days about the installation of tele sets in theatres.

The writer still can't see television as an adjunct to the motion picture theatre, whether in England or in the U. S. Television, in order to pay its way (and pay it must or be ousted as a potent merchandising medium), is destined to be strictly a home product, much as is radio today. Why should anybody pick himself up and repair to any communal center to see, even on a slightly larger screen, the identical program he can see right in his own home and without even taking off his slippers or putting on a necktie? The answer is simply that he won't.

In conclusion, it can be said that if the picture business would stop horsing around and playing fast and loose with its present welfare and future prospects (and we mean *all* branches of the industry) everybody concerned—and this means projectionists on jobs—might experience a feeling of security relative to the years immediately ahead. Also, both the producers and Labor might get together and see just how the picture business can best meet the challenge of home television, instead of standing off in the distance and pouting at the tele workers the while they calculate the odds on the fifth race. This procedure, of course, calls for the application of some common sense, which may be asking a bit too much of the bonus boys.

Meanwhile Mr. Projectionist has just as much at stake and should be as avidly interested in the course of the Neely Bill, in the outcome of the Government's demand for the breakup of distributor-controlled theatres, and in cheap smuggling and tax-evasion activities by industry big shots as they are in those happenings closer at home, such as union jurisdictional battles and the like.

ALTEC TUBE GUARANTEES

Vacuum tubes supplied for theatre sound systems by Altec will in future receive a tenfold increase in life guarantee. Tubes previously guaranteed for 100 hours service will now receive six-months unconditional guarantee. The large 50-watt size, now guaranteed for 100 hours, will be subject to an extended pro-rata guarantee on any tubes which fail within 1000 hours.

I.A.-Equity Row Threatens Amusement Field Tieup

PRACTICALLY no person with eyes to read need be informed about current happenings affecting the showbusiness labor situation, as the press wires into even the smallest country newspaper have been kept hot with releases, very palatable because of the motion picture angle, anent the I. A.-4 A's battle before the A. F. of L. Executive Council. This summary therefore need be only a review of these inter-Labor high jinks.

The war was on when the 4 A's, following hearings, suspended the charter of its affiliated A. F. A., tossed out its leaders — Ralph Whitehead, Sophie Tucker and Harry Richman—and chartered another unit, the A. G. V. A. under the temporary leadership of Eddie Cantor, to take over the jurisdiction of all show-business people except picture workers. Miss Tucker and Richman, highly regarded by Equity, were ousted for stringing along with Whitehead, who was really the only one the 4 A's were gunning for.

What happened thereafter is spread in copious measure on the pages of newspapers all over the country. President George Browne promptly issued an I. A. charter to the Tucker-Richman-Whitehead group; and the 4 A's promptly appealed to the A. F. of L. Council meeting in Atlantic City, charging that the I. A. action was the "most barefaced jurisdictional raid in the history of the A. F. of L.," and particularly so in the absence of any referendum vote among either the A. F. of A. or the I. A. memberships as to their wishes in the matter.

● Browne Defends I.A.

I. A. leader George Browne replied significantly that under the I. A. Constitution he didn't have to consult the I. A. Executive Board or its membership before issuing the actors' charter; that he considered the I. A. charter from the A. F. of L. gave his organization jurisdiction over *all workers* in the entertainment field, including actors; that the 4 A's as late as 1930 had asked the A. F. of L. to define their jurisdiction, and that when the 4 A's revoked its affiliate's charter it in effect left 12,000 performers "homeless and with no place to go"—except possibly into the C. I. O. ranks. This blast exceeded by a wide margin previous statements by President Browne that he felt the I. A. was entitled to film players.

After a bitter battle of words unparalleled in the history of the A. F. of L., the Executive Council acceded to all the Equity demands, ruling that the 4 A's had permanent jurisdiction over all talent and barring the I. A. from any future activity in that field. It was also provided that the Tucker-Richman-Whitehead group be reinstated in the A. F. A., the charter of which would be restored; that a committee be appointed to handle A. F. A. affairs for ninety days, after which time an election of officers would be held. This decision, a bitter blow to I. A. aspirations, apparently settled the question.

Equity promptly knocked over this proposed settlement, however, despite their acceptance of all sections save one of the Council's decision, by refusing flatly to accept Whitehead under any circumstances, althought both Richman and Miss Tucker were "more than welcome home." The A. F. of L. Council reply to the 4-A's reaction was in effect that the latter must accept the Council decision 100% or not at all. Equity decided that it would be not at all. The I. A. let it be known that either Whitehead would be reinstated or the battle would continue. President Green made frantic efforts to placate the combatants, even to the extent of finding a slot for Whitehead in some other labor union; but the latter refused to play on this basis.

The situation as these lines are written

has a number of interesting angles, as follows: Equity won't accept Whitehead, therefore the I. A. won't surrender its charter to the Whitehead-Tucker-Richman combine; Miss Tucker will be brought up before the Equity Council on charges of misconduct, the penalty for which will not be less than suspension, meaning that she can't work with other Equity members; Whitehead, with I. A. backing and charter still behind him, will continue to organize in the entertainment field, even while Equity pushes its organizing campaign among the same people in behalf of its newly-chartered A. G. V. A., headed by Cantor; strike talk is heard on the part of both Equity and the I. A., with each awaiting a move by the other—all of which must await the A. F. of L. Convention this Fall before another request for settlement by the parent body can be made.

The crucial test will come on Sept. 4 when the musical play in which Miss Tucker is starred, "Leave It to Me" (h'ya V?), is scheduled to reopen in N. Y. after a summer suspension. If Miss Tucker is suspended by Equity, as appears certain, she will be barred from working with other Equity members in this show. Should this occur, it is considered certain that the I. A. will retaliate by striking the show. Producer Vinton Freedly of the "Leave . . ." show, who has already postponed its reopening one week to Sept. 4 as a result of the Equity-I. A. tangle, announced that he will not reopen without Miss Tucker. He might save the situation temporarily, of course, by passing up the short N. Y. run of the show, but this would not solve his problem when "Leave . . ." embarks on its projected road tour, which Freedly ardently desires to sponsor.

This probable series of happenings will at once draw the first casualties of the fuss and signal the opening of a nation-wide labor war in the entertainment field. The picture producers, through Joseph Schenck, let it be known that they sympathized with the actors in the dispute.

Sharply Contrasting Technique

The tactics employed by both the I. A. and Equity during the dispute provides an interesting contrast in technique. President Browne, for the I. A., issued the actors' charter and then sat back with a "So what?" attitude to await Equity's move. The latter, according to seasoned Labor men, made two serious mistakes. First, nobody questioned the right of Equity to take such action as it deemed necessary relative to the status of an affiliate. All Internationals including I. A., reserve this right. However, it is pointed out that since Equity made no secret that it was gunning for only one man, Whitehead, smart procedure would have prompted retention of the A. F. A. as an affiliate, the while it preferred charges against Whitehead *as an individual member*, to be acted upon by the Equity Council. Or Equity could have moved in and taken the A. F. A. under its wing, while it dealt with Whitehead, which action would have automatically rendered powerless the Whitehead-Tucker-Richman group of officers. Many internationals follow this procedure.

Second, when the A. F. L. Council handed down its decision, Equity could have accepted the ruling 100%, including Whitehead's reinstatement, because it is conceded by all concerned that the general membership would support Equity in any referendum or election vote. Of course, much merit is attached to the Equity assertion that Whitehead's reinstatement would place the election machinery in his hands and thus give him a great advantage.

In the final analysis Whitehead is the key

figure. Thus it is that the status of one man is the hinge upon which the whole controversy turns, a situation which threatens to embroil the theatrical field in a controversy *par excellence*, throw 150,000 people out of work and endanger the welfare of the entire amusement world.

10% of Production to East, Ask N. Y. Labor Groups

Resolutions passed at 10th District (N. Y. State) I. A. Convention included one aiming at 100% organization of the Schine Circuit and request that at least 10% of present Coast picture production be allotted to N. Y. Latter resolution (also approved by N. Y. State Federation of Labor) sets forth that 50% of pictures use N. Y. City as background for story, that a large portion of production money is advanced by N. Y. banks, that the largest distribution market is N. Y. City in particular and N. Y. State in general, and that 10% of the total production, if made in N. Y., would employ about 10,000 people directly and 40,000 indirectly. Sol Scoppa of the Lab. workers sponsored the resolution.

RECTIGON PRICE SLASH

Westinghouse announces a price reduction on the 15-ampere, 60-volt Rectigon bulb from $12 to $10. This bulb is used principally in motion picture rectifiers.

PROCESS PROJECTION

(*Continued from page* 16)

universal motor to give a variation in the speed of focusing. This focusing device should be easily released for manual focusing.

FIRE SHUTTER (Basic):

The design shall include a fire shutter with a device to secure positive full opening when the machine is running. If of the centrifugal force opening type, an indicator should be incorporated so that the operator can at all times tell that the fire shutter is fully opened. This fire shutter should not open until the projector has reached the speed of 1200 rpm., and should close by the time the projector has slowed down to that speed. This opening and closing speed should be adjustable to meet special conditions where an operating speed of less than 1200 rpm. is necessary.* An auxiliary control should be included so that the light can be flashed without the necessity of running the machine.

FILM BREAKAGE (Basic):

A positive operating buckle-trip device shall be included which will stop the mechanism under conditions of film breakage, loss of loop, or take-up failure. (See "Forward and Backward Operation of Projector Head".)

(Auxiliary): A contact breaker or mechanism to disengage the drive system has been suggested as a means of meeting the above basic recommendation.

NOISE LEVEL (Basic):

The noise level of the projector head in operation shall be 3 db below the noise level specification given for the whole equipment in that part ("Noise Level") of these recommendations. This recommendation is to be met without the use of a booth or cumbersome blimp.

*NOTE: The amount of this adjustment to meet special conditions shall be determined by the intensity of the light source, degree of shutter opening, and speed of operation.

MAGAZINES (Basic):

The magazines shall be so designed as to be adaptable to reel or spool (optional) take-off and take-up and shall accommodate up to 1000' reels.

LENS MOUNT (Basic):

A sturdy lens mount of sufficient size shall be provided to permit the use of all specified focal length lenses, with a speed of F1.6 (see "Standards of Lens Mount Diameters"). Proper stability should be provided to eliminate movement and vibration and to keep the lens always in its proper focal position. Then lens must accurately rack in and out along its horizontal optical axis and not revolve while focusing.

High Speed Head

OPERATING SPEED OF HEAD (Basic):

A high speed projector head shall be provided which will operate at a

speed of 120 frames per second with perfect registration, giving a minimum amount of abrasion to the film. The high speed projector head shall fulfill the recommendations given under "*Normal-Speed Head*," with the exception that the noise level specification may be disregarded. However, additional specifications as given below must be met.

HIGH-SPEED HEAD FOR MINIATURES (Basic):
In the event that by substituting the ***High-Speed Head*** for ***Normal-Speed Head***, the above speed requirement cannot be adequately accomplished or reconciled with steadiness, it has been suggested that separate heads for high speed be developed. Special high-power motors will be required and shall be designed to adequately operate the projector at a speed of 120 frames per second.

SHUTTER CONTROL (Basic):
A positive synchronizing shutter system shall be provided to eliminate the possibility of shutter slippage. (See "Synchronizing".)

VIII. NOISE LEVEL

MAXIMUM NOISE LEVEL (Basic):
Considering noise measurements made at 45° positions about the projector and at a distance of 6′ from the projector, using a meter which employs a 40 db ear loudness weighing characteristic and calibrated with respect to the standard reference noise *level* of 10^{-16} watts per square centimeter, the maximum allowable noise level from the whole equipment shall be 34 db.

IX. TRANSLUSCENT SCREEN

BASE COMPOSITION (Basic):
All screens shall be made with a safety-type base—cellulose acetate or an equivalent *comparable to clear base acetate film*—this base to be of such quality that no discernible color change is noticeable over a two-year operation period. When a diffusion surface is applied to the base, this surface should be readily removable so that the screen may be easily refinished in the event the surface is damaged.

LIGHT TRANSMISSION, FIELD, DEFINITION (Basic):
The screen, over its entire area, shall be so designed as to provide: (1) optimum transmission (see above paragraph); (2) optimum diffusion, diffraction, or refraction characteristics; (3) as flat a field as possible; and (4) uniform definition.

STANDARD SCREEN SIZES (Basic):
The Committee recommends that motion picture producing companies, manufacturers, and commercial organizations engaged in process and miniature work standardize upon the following screen sizes (specified as useable inside area, exclusive of binding):

Height	*Width*	*Height*	*Width*
5′ x	7′	16′ x	21′
8′ x	10′	18′ x	24′
11′ x	14′	24′ x	30′
14′ x	18′	27′ x	36′

X. SCREEN ILLUMINATION

STANDARD METHOD OF MEASURING SCREEN ILLUMINATION (Basic):
The following method of measuring the amount of light falling on a screen is recommended: The full screen aperture of the projection machine is flashed with the shutter open and stationary. Nine readings of the light intensity are taken at different points on the projection side of the screen—the four corners, the middle of the top and bottom and the two sides and the exact center of the image. The measurements at the corners and edges are made by placing the center of the cell in from the edge 5% of the total width and in from the top and bottom 5% of the total height of the projected image.
The exact height and width of the projected image is measured and the area of the image computed in square feet. The number of square feet of the image is multiplied by the average of the nine foot-candle readings. The result is the number of lumens delivered to the screen by the light and optical system in question.

TYPE METER (Basic):
It is recommended that measurements of screen brightness be made with the Weston Foot-candle meter, Model 603, with the cells filtered by means of the Weston Viscor filter which approximates the color sensitivity of the human eye.

METER CALIBRATION (Basic):
It is recommended that all meters used in the measurement of screen brightness be calibrated at least twice a year against known standards. It is further recommended that this calibrating be done by an organization properly equipped and authorized by

the Weston Laboratories to adjust and calibrate Weston meters.*

MINIMUM LIGHT INTENSITY OF SCREEN

It has been suggested that the minimum intensity of illumination at the screen, considering the speed of the lens system used, be as follows: The minimum output of a conventional condenser system using an F2.3 system be 12,000 lumens; an F2.0 relay type system, 16,000 lumens; and an F1.6 relay type system, 25,000 lumens.

*NOTE: The Weston meter, Model 603, is recognized as standard in Hollywood. Meters which do not have proper care and protection from rough handling may require calibration oftener than twice per year.

(THE END)

S.M.P.E. PROJECTION AND EXCHANGE GROUPS REPORT

(*Continued from page* 10)

example, the Committee is awaiting further reports from its members and from other committees of the Society and from the Academy of M. P. Arts & Sciences on the relative merits of various modes of processing release prints, and as soon as all the material is available, the Committee will be able to report further on the subject.**

● Handling Release Prints

The problem of mutilation and mishandling of release prints has received very close attention by the Committee. Although the 2000-foot reel has received complete acceptance by the industry and has proved very successful, a number of minor problems have arisen during the period of adjustment of the industry to the new size.

The weight of cases, for example, has met with objection in some quarters and seems to have aroused a feeling that rough handling of the cases must be expected and tolerated as something inherent in the business. The Committee is trying to discourage this idea and to show that what is now regarded as "ordinary" wear and tear should no longer be regarded as ordinary. Contacts have been made with the various carriers of film, and good cooperation has been shown. It is expected, therefore, that some improvement may soon be evidenced in this direction.

Recently the question has been revived as to which is the better way of shipping film from the exchanges to the theatres—"heads up" or "tails up." About two years ago, the Committee made an extensive study of the subject, principally in the interest of determining the best method of splicing. Drawings and data obtained from the film stock manufacturers showed that the most satisfactory splice was

**NOTE: These data have now been made available by the Academy, the findings having been published in I. P. for May, 1939, p. 20 under the heading, "Film Preservative Tests".

made when the film was wound in the "head-to-tail" direction, that is, leaving the tail out.

A survey indicated that almost 88 per cent of the films returned to the exchanges had the tails out. This meant one of two things, *viz.*, either the majority of the theatres of the country were not equipped with special reels, or they could (or would) not spare the additional time required for rewinding in order to return the film to the exchanges "heads up."

The representatives of the various companies on the Committee felt that some expense might be involved if it were decided to adopt the "tails up" system, which involved an additional rewinding at the exchange. Nevertheless, they were willing to go to this expense if, as a result, the quality of the films delivered to the theatres and the resulting projection should prove much better. However, in view of the overwhelming figures indicating that projection in general was definitely on a "tails-out-return-to-branch" basis, the project was abandoned, and since that time it has not been brought before the Committee again.

● **Lacquer, Scrap Film**

With regard to the use of lacquer in splicing film, investigation showed that there was no uniformity of practice among the exchanges, some of them not using lacquer at all and others for first-run films only. The efficacy and necessity of using the lacquer are now being studied further by the Committee.

The problem of disposing of scrap film was also under consideration, and a canvass of the companies was made to determine what the current practices were. It was found that general procedure in the exchanges was satisfactory and according to regulations, although differing somewhat in details. This brought up the question also of fire regulations in exchanges, and as it was reported that the NFPA was engaged in revising its "Regulations . . .," a sub-committee appointed for the purpose drew up a set of suggestions, relating to exchanges, for the consideration of the NFPA.

Other subjects under consideration by the Committee include methods of blooping, dryness and brittleness of film, cleaning films in exchanges (several of the companies are now cleaning their films, with gratifying results), and handling and storing film cement. In addition, the Committee has investigated a number of new devices, such as film cleaners, metal and fiber reel bands, new designs of shipping cases and reels, *etc.*

Plain Talk to Projectionists, Dealers and Purchasing Agents

By *LARRY STRONG*

MEMBER, I. A. CHICAGO LOCAL 110; PRACTICAL PROJECTIONIST FOR 30 YEARS; MANUFACTURER OF PROJECTION EQUIPMENT FOR 20 YEARS

THREE months ago we introduced FILM-WELD, which won immediate widespread acceptance because of its obvious superiority to ordinary film cement. Since then much nonsense relative to film splicing in general and film binding agents in particular has been circulated—most of which emanated from distributors of ordinary film cement.

The campaign against FILM-WELD includes the following untruths: (1) FILM-WELD advertising contains many exaggerated statements (2) "anybody" can make a product similar to FILM-WELD (3) sponsors of FILM-WELD are "fly-by-night" people and therefore unreliable.

Considering these statements in order, our reply to (1) is to repeat our previous claims for FILM-WELD as follows:

- ***Will not thicken, spoil or discolor.***
- ***Retains its full strength to the last drop—even when left uncovered. Requires no thinning agent.***
- ***Firmly binds all film—nitrate, acetate, color stock.***
- ***Goes twice as far as cement.***

And that's not all. We now assert that, *in addition,* FILM-WELD will (a) not only bind acetate (safety) film to itself but will also bind acetate stock to nitrate stock (b) make a thinner splice than any cement (c) positively *not* buckle film, and (d) effectively dissolve the splice-resistant coating laid on film by the pre-release protective treatment now used by all major distributors!

(2) "Anybody" *can't* make a product "similar to" FILM-WELD, which is a unique *patented* formula.

(3) The sponsor of FILM-WELD, far from being a "fly-by-night" person, has been a working practical projectionist for 30 years as a member of I. A. Local 110; has manufactured fine projection equipment (including the famous Strong Changeover) for the past 20 years, and has done business with thousands of projectionists and every supply dealer in the industry.

Competitors of FILM-WELD dare not deny that it makes a fine bind; they merely mumble that "it hardens". We challenge anybody anywhere to produce an ounce of FILM-WELD that has even thickened—with or without the cover removed!

Projectionists are weary of sticky film cement that hardens, that requires thinner and makes a bumpy patch that not infrequently comes apart, particularly on pre-release treated prints. That's why they are flocking to those progressive dealers listed on this page to obtain FILM-WELD, the modern binding agent that looks and flows like water but which binds film instantaneously and permanently.

Buy your FILM-WELD at these progressive dealers. Remember — FILM-WELD is the only binder that is sold on a *money-back-if-not-satisfied basis.*

★ Film-Weld ★

TRADE MARK

. . . is now being purchased by smart projectionists from these progressive dealers (who know a good thing when they see it):

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Amusement Supply Co.
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Western Theatre Supply Co.

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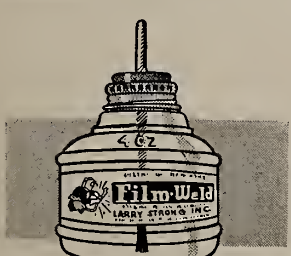

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Chicago, Illinois

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INTERNATIONAL PROJECTIONIST

SEPTEMBER 1939

VOLUME 14 • NUMBER 8

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THE PUBLIC

IS BEING TAUGHT TO DEMAND *More Light*

MORE LIGHT is the slogan of the day. From newspapers and magazines, the lecture platform and the school, the public is being taught the sight saving value of plenty of light.

Put your theater in step with this upward trend in light intensity. It has popular appeal. People like to enter a theater in which they can *see* their way to their seats. And they can do just that in the many theaters that are now equipped with high intensity projection.

Think this over if you still have low intensity projection. Those first minutes of blindness result from the low level of general illumination necessitated by lack of light on the screen. Don't let poor lighting drive your patrons to other theaters. Install Simplified High Intensity projection and attract that growing body of theater-goers who appreciate plenty of light.

Write for a free copy of the booklet, "The Eternal Triangle in Picture Projection."

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International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

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Monthly Chat

DURING the month ensuing since we commented on the many and varied new additions to the motion picture projection equipment lists we have been troubled by the thought that in all this pushing, tearing and tugging on the part of equipment protagonists to gain maximum display space for their products one or more unworthy appliances might sneak under the ropes and gain widespread acceptance in the field before the brakes could be applied through the medium of the printed word.

This statement is not a left-handed way of imputing unworthy motives to the sponsors of new equipment; on the contrary, they are to be congratulated and aided in every possible way. Nor is it our intent to indulge in any subtle criticism of the new products now being offered. Yet we would gladly do without several new and worthy units if this were the price of ducking a single unworthy one.

This business of new products should be of the utmost concern to all projectionists, for in the great bulk of theatres throughout the world (we exclude the plutocratic circuits which employ supervisors) the projectionist is the only person on the premises who knows with any degree of certainty the difference between a p. e. cell and an intermittent movement. This is precisely the reason why I. P. has always considered the prompt dissemination of news pertaining to, and a searching analysis of, new equipment to be its prime function. And this is precisely why projectionist readers of I. P. should avidly scan any and all such announcements, even to the point of registering instant disapproval of any conclusions drawn by I. P. with which they disagree. In fact, this latter course is ardently to be hoped for by any editor worthy of the name. Only through a free and full discussion of such topics (long the cornerstone of I. P. policy) can we hope to advance.

Progress is inevitable in projection no less than in any other art; but we shall not withhold our punches against trick devices that hove into view under the banner of progress.

• • •

The indefatigable Phillips researchers in Eindhoven, Holland, make sporadic forays in behalf of mercury vapor lamps as a projection light source, which sallies are invariably the signal for those technical writers who should know better to proclaim the problem solved, to the dismay of the cautious Phillips group. Ditto for television; although the fickle British now scorn a previous love, theatre television.

• • •

Progress note: Exchange managers, shown a unique footage indicator that pastes right onto the real band, remarked: "Why should we help out those projection birds?" Guess the craft is just a pushover for double-reels.

INTERNATIONAL PROJECTIONIST

VOLUME XIV NUMBER 8

SEPTEMBER 1939

Ashcraft 'Cyclex' Projection System

UTILIZING a means of arc power supply which differs radically from any system yet put to practical use in the projection field, the C. S. Ashcraft Mfg. Corp. is now introducing to the field a new lamp and accompanying power unit under the overall designation of Cyclex*. This article, in the nature of a preliminary report and outline of the highlights of this new system, undoubtedly will evoke no little comment by workers in the field, which will serve admirably to supplement a more detailed exposition of the equipment which will appear herein subsequently.

What is evidently the solution of a vexing projection problem for the medium- and small-size theatres is now at hand. Heretofore those theatres not wishing to go into the higher brackets of illumination, with correspondingly greater expense, have had to utilize low-intensity lamps, which give a yellow light. Recent demonstrations by Ashcraft reveal the availability of a white light source of at least twice the intensity of low-intensity and at a much lower cost.

* Registered Trade-Mark.

By *JAMES J. FINN*

Briefly stated, the Cyclex system of projection offers an arc which operates on alternating current and, through the use of the aforementioned power unit, removes the objections heretofore cited against this type of arc. A condensed summary of data anent the Cyclex arc follows:

1. Power: 55-58 amperes at 19 volts, supplied by a special rotary converter, or frequency changer, which serves both arcs.
2. Carbons: two Suprex 7 mm. positives.
3. Output: will supply 12 ft. candles of illumination (screen center) on a 17-foot screen.
4. Color of light: white.
5. Cost: Average overall cost (power and carbons) of 10c an hour, as compared with Suprex cost of 24c and a low-intensity cost of 18c.

The first publication anywhere of a projection development that, years in the making, has been the topic of endless speculation as to its whys and wherefors. Here are the facts—first in I. P., as is usual with all new motion picture technical developments.

The Cyclex arc is intended primarily for those small- and medium-size theatres which are now using low-intensity arcs. There can be no question as to the superiority of Cyclex light in both quantity and color over that of the low-intensity arc.

● The Problem Faced

Naturally, projectionist interest is focused upon the means employed to overcome the obvious shortcomings of previous a.c. arcs—and therein lies a tale which properly requires a retracing of steps to review previous experiences with a.c. arcs, notably that of some six years ago when Suprex was first introduced.

With conventional a.c. arcs using 60-cycle current the front carbon is the only one in focus with the mirror, or reflector, and is alternately positive and negative 60 times a second. When the carbon is positive, light is projected to the screen; but when the carbon is negative, very little light is projected. It follows, therefore, that the screen is

alternately bright and dim 60 times per second.

With the shutter idle, the flicker will not be apparent because of the inability of the eye to follow such rapid changes in light intensity, the result of the phenomenon known as "persistence of vision."

In the case of a d.c. arc, however, the carbon in focus with the mirror will be positive constantly and the projected light will be of constant intensity. Such a light will appear no different to the eye than that projected by the 60-cycle a.c. arc—*that is, without the shutter running!*

● Shutter Action Effect

We turn now to consideration of the effect of shutter action. The shutter, having two blades and two openings and running at the standard speed of 24 revolutions per second, will cut off the light from the screen twice with each revolution. Therefore, the *frequency* of the light projected by a d.c. arc, due to shutter action, will be 2 x 24, or 48 cycles, per second—which frequency, if the light be of high intensity, can be detected by the human eye.

This effect may be termed *inherent flicker*, since it is a characteristic of the projector and bears no relation to the nature of current supplying the arc. The degree of visibility of this flicker depends upon only two things: the *intensity* and the *color* of the projected light.

It has been noted that light projected by a 60-cycle a.c. arc has no visible flicker, but that light projected at a frequency of 48 cycles per second (the shutter frequency, remember) does present a visible flicker provided the intensity of the light be high enough. Now, it is obvious that the lower the frequency below 48 cycles the more noticeable will be the flicker. In other words, while projected light interrupted 60 times per second appears to be uninterrupted, and light interrupted 48 times per second is passable, any interruption of the light at a rate lower than 48 times per second will result in objectionable flicker.

The logical question now presents itself: If we project a light that is interrupted 60 times per second, and then cut into this light with a shutter that in and of itself interrupts 48 times a second this *already interrupted light*, what is the result? The result of this imposition of shutter frequency upon current frequency is stroboscopic and the difference between the two frequencies is manifested by a very objectionable flicker. Incidentally, the type of shutter used has no bearing on the results obtained.

The only possible solution to this problem is to determine a harmonic (mulitple) of the frequency of the inherent flicker (48 per second), the use of which would not require either electrical or mechanical interlocking means. A 48-cycle current would require interlocking of both the converter and the projector drive motor, if flicker is to be eliminated, plus a phase-adjusting device so that when the current cycle is producing the maximum amount of light the shutter opening is permitting the maximum amount of light to pass through. Such a means is wholly impracticable.

Ashcraft has found that if a current frequency of 96 cycles be used, interlocking is unnecessary. In other words, the first, third, fifth and other odd multiples—such as 48, 144, and 204 cycles—do not lend themselves to the Cyclex system; but the second, fourth, sixth and other even multiples—such as 96, 192, and 288 cycles—are satisfactory.

Explaining his choice of this frequency, Mr. Ashcraft states:

● Genesis of Cyclex

"Cyclex is based on the co-ordination of light impulse frequencies. Standard projection practice is at the rate of 24 pictures per second and the interruption of the light at the rated 48 times per second. We have discovered a means of operating the arc so that at the standard rate an equal amount of light is passed through each and every shutter opening, and a like amount of light is intercepted by each shutter blade. This, of course, is exactly the case existing when a d.c. arc is employed; but we accomplish the identical result with a.c.

"The speed of the shutter is immaterial, in a way, as Cyclex does not depend on exact speeds. However, where projection is at exactly 90 feet per minute the arc supply frequency is about 96 cycles.

"The reason for the selection of such a frequency is apparent when an analysis is made of various arc current supply frequencies used in conjunction with standard shutter practice. Such analysis shows two factors present in the periodic beat apparent on the screen: pulsation frequency and pulsation intensity.

"The pulsation intensity curves do not follow the pulsation frequency curves. but at two points only do they coincide at the zero point, the first at 96 cycles the other at 192 cycles. The first was chosen due to the greater simplicity of frequency conversion. At the point of contact with the zero line the curve is comparatively flat. This characteristic allows a latitude or usable band of frequencies from around 96 cycles, however, we can hold the frequency exact if necessary and apply the latitude to a change in projector speeds.

"At 96 cycles one complete cycle of light will be projected through each shutter opening, as one shutter opening passes each 1/96 of a second. There will be four complete light cycles each shutter revolution and, the blades being of equal width to the shutter openings, will intercept one cycle of light also.

"An analysis of the graphs of the current frequency at 96 cycles superimposed on the time periods of shutter openings and closings discloses that although only one-half the light is projected during the half cycle below the zero line, or from the carbon facing away from the reflector, an equal amount of light is projected through each shutter opening continuously regardless of any change of phase relation

Installation of Cyclex projection system, showing lamp and relative size of power unit and control cabinet to other projection elements.

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Perkins Electric Co., Montreal
J. M. Rice Co., Winnipeg

SO SENSATIONAL has been the progress and so widespread the acceptance of FILM-WELD that now, only four months after its introduction, 85 dealers serve the motion picture industry with this modern film-splicing medium. This record of blanket coverage—made possible by the enthusiastic approval of film technicians—has never been equalled in this field.

And why not? FILM-WELD performance is more than sustaining every one of the following claims made for it:

- *Will not thicken, spoil or discolor.*
- *Retains its full strength to the last drop—even when left uncovered. Requires no thinning agent.*
- *Firmly binds all film—nitrate and acetate, black-and-white and color stock.*
- *Goes twice as far as ordinary film cement—naturally.*

Projectionists are weary of sticky film cement that hardens, that requires thinner and makes a bumpy patch that not infrequently comes apart, particularly on pre-release treated prints. That's why they welcome FILM-WELD, the modern binding agent that looks and flows like water but which binds film instantaneously and permanently.

The dealers listed on this page handle and endorse FILM-WELD because they believe in progress and are anxious to serve you better. Patronize them not only for FILM-WELD but for the best in projection supplies. Remember—FILM-WELD is the only film binder that is sold on a money-back-if-not-satisfied basis.

LARRY STRONG, INC.
1241 South Wabash Avenue
Chicago, Illinois

between the shutter blades and the current cycle."

● **Cyclex Power Unit**

The Cyclex power unit, warranted by Ashcraft to be indestructible, utilizes only ¾ h.p. for driving the rotary transformer. This latter unit consists of a stator upon which is wound the primary connected directly to the commercial frequency power line. The rotor is the secondary, with each 30 revolutions of the transformer increasing the frequency 1 cycle. Ordinarily the speed is at the relatively low rate of 1080 revolutions.

The current of higher frequency is taken from the rotor by brushes operating on slip rings. The brush current density is only one-half that for which the brush was designed, the maximum current being only 10 amperes at 90 volts—thus the wear is infinitismal.

Both Cyclex arcs are operated from a simple rotary unit, yet current is never supplied to both arcs from that unit simultaneously. By means of two small static transformers, with the secondary of each connected to its respective arc, and a suitable switching device, one arc is heated on commercial frequency (60 cycles while the other is operating on a higher frequency supplied by the rotary transformer. The arcs may be switched from one current to the other at will, the change being just as rapid as the electrical change-over devices. The automatic relay is connected direct to the ordinary change-over device, requiring no extra motions.

Ample taps are provided on the secondaries of the transformers for arc current adjustment. While the present machines are of the sleeve-bearing type, ball-bearing rotary units are available at a slight extra cost. Also, any method of electrical or hand change-over device is applicable to the cycle relay, including slide rods, ropes or pulley types. V-belt and pulleys are used for power transmission. While less than ¾ h.p. is transmitted, the apparatus is designed for 2.4 h.p. It is very quiet, easy of assembly, and provides means of frequency adjustment for various projection machine speeds, the upper pulley being of the variable pitch type.

● **Arc Characteristics**

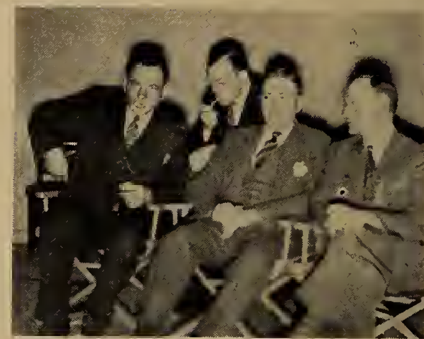
The Cyclex arc has no characteristics in common with other arcs, either a.c. or d.c.; in fact, the Cyclex arc is operated in a manner which is directly contrary to previous practice. Conventional a.c. arcs utilize an arc gap of from .270 to .350 inch; the Cyclex arc gap, is of the order of from .100 to .125 inch.

Cyclex arc regulation is accomplished by means of a motor without commutator or brushes and which draws no more power at full load than it does at no load; this motor is also warranted to be indestructible. The relay for automatically feeding the carbons is warranted to be exact at all frequencies, which feature is ascribed to a method of combination series and differential shunt control. One carbon trim is rated to burn 4½ hours, thus making possible a 9-hour show on both lamps.

Additional detailed information relative to the theory, construction and operation of the Cyclex arc will appear in subsequent issues of I. P.

Projectionist Day at N. Y. World's Fair

PROJECTIONIST DAY at the New York World's Fair was observed on Sept. 7 by more than 450 projectionists and friends of the craft who assembled in the Special Events Building and participated in a three-hour program which was intended to direct the attention of the general public to the attainments of a group which, though inconspicuous, contribute greatly to the continuing success of the motion picture industry.



Plutocratic projection supervisors—and one rose: Henry Behr, Wilmer & Vincent; Jim Finn; Frank Cahill, Warner Bros., and Harry Rubin, Paramount

Upon completion of the official program numerous groups banded together and toured the Fair grounds throughout the day. Undeniably these groups made their presence felt, but there were no casualties.

E. A. Williford, SMPE prexy, and Dr. A. N. Goldsmith, enjoy a laugh

The event was a signal success measured in terms of attendance by representatives of many Local Unions from far and near no less than because of the spirit displayed by participants in the program. But of far greater significance, and attesting to the widespread interest evoked by the occasion, was the deluge of enthusiastic messages which descended on the Program Committee from Local Unions which were prevented, either by distance or other factors, from being directly represented at the meeting. At least a half dozen such messages were received from each state and from Canada. In addition, the event received a splendid press—all of which cannot fail to add immeasurably to the stature of the projectionist craft.

Many hands played many parts in the manifold details incident to the planning and execution of the program, but the record should show that the success of the affair—nay, the reason for its very being—is due to the individual efforts of P. A. McGuire, of International Projector Corp., who handled general arrangements for the affair. Others pay lip service to the worth and standing of the craft; but "Mac" apparently is the only one who ever translates words into action and thereby contributes something to craft welfare.

● **On the Speakers' List**

Among the prominent personalities who appeared on the program E. A. Williford, of the National Carbon Co., who spoke as president of the S.M.P.E.; Dr. A. N. Goldsmith, widely known

Nat Golden, W. Byrne, L. U. 306, and Dick Hayes, L. U. 650

consulting engineer and past-president of both the S.M.P.E. and the I.R.E.; Nat Golden, chief of the Motion Pic-

All save one represent the Simplex Sound Dept.: H. Mayer, RCA; and Messrs. C. Thompson, C. Alexander, G. Freidl, director, J. Stephans, E. Shortt, H. Barnett, K. Schneider, E. Jones, W. Borberg, C. Soehl, L. Reinhold, L. Thome, E. G. Mercier, and E. Pirner

ture Division of the U. S. Dept. of Commerce and himself a member of Cleveland Local 160; Joseph Basson, president of N. Y. City Local 306; William Reid, of Atlantic City Local 310, the first projectionist in America and who still is active; F. H. Richardson, and Richard Hayes, of Westchester, N. Y., Local 650, who voiced the regret of I. A. President George E. Browne at being unable to be present. James J. Finn, editor of I. P., also spoke, but, he being just a projection mug, nobody would ever suspect it through reading the various exhibitor papers. March of Time made available the reel "The Movies March On" as a climax piece.

Paul Reis, Nat. Carbon Co.; J. K. Elderkin, of Forest; Jimmy Burke, b.a. of Boston L. U. 182; Ray Duport, also of Forest, and George Freidl, of I. P. C.

Among those also present and spotted were Thad Barrows and Jimmy Burke, of Boston Local 182; Arthur Martens and Dick Hayes, of Westchester, N. Y. Local 650; a large delegation from N. Y. City Local 306 including Wally Byrne, b.a., Joe Campbell and a group from Miami, Fla., Local 316, who easily copped the prize for distance; a group from Georgia; A. J. Payette of Springfield, Mass., Local 186; George Friedl and a group of ten of his sound dept. workers from International Projector Corp.; Walter Green, president of National Theatre Supply, and Bert Sanford of Altec Service.

Also, Paul Ries, National Carbon Co.; J. K. Elderkin and Ray Duport, of Forest Mfg. Corp.; directors of projection: Harry Rubin, Paramount; Henry Behr, Wilmer & Vincent, and Frank Cahill, Warner Bros., and a delegation from Long Island, N. Y. Local 640.

What was said and by whom follows:

FUTURE OF THE PROJECTIONIST

By Dr. A. N. Goldsmith

Consulting Engineer, New York, N. Y.

FELLOW workers in the motion picture field: Your capable Committee on Arrangements, including its dictatorial Chairman, Mr. McGuire, have told me that I should be here today to say something to you about the art of the projectionist, past, present, and future. However, it took little of their arbitrary authority to induce me to be here, since I have always felt closely akin to your group, have admired your work, have appreciated its fundamental importance, and have had faith in its future.

The position of the projectionist in the motion picture field is rather a peculiar one. He is taken for granted by practically everybody and it is calmly assumed that his difficult job will be done—and done well. The producer, the distributor, the exhibitor, and the audience alike take it for granted that the picture and sound will be delivered satisfactorily and that "the show will go on." In a way, this is a high compliment. If a job is usually done so thoroughly and well that it becomes almost a routine matter and that everybody expects it to be satisfactory, it is a tribute to the care and consistent effort of the projectionist.

Yet I think that this attitude fails to appreciate the importance of the projectionist in the motion picture set-up. We hear all about the glamorous stars in Hollywood, but every bit of this glamour has to pass through less than a square inch of film gate to reach the audience. We are impressed by the elaborate stage sets and studio equipment on the West Coast, but it is the projectionist who delivers the re-

(*Continued on page 26*)

Joe Basson, cornered, forced to listen to Thad Barrows, L. U. 182 prexy, give out anent alleged Boston culture

Henry Behr, J. K. Elderkin, Forest Mfg. Co., and A. J. Payette, Sec. of L. U. 186

Chairman P. A. McGuire Thanks All 'Day' Participants

At the conclusion of the addresses P. A. McGuire, of the International Projector Corp., Chairman of the Arrangements Committee, made a brief announcement, stating: "We are not here to see motion pictures as entertainment for that will be found in the elaborate recreation provided by the New York World's Fair. But 'The Movies March On,' shown through the courtesy of March of Time, fits in very well historically with the program we arranged for Projectionist Day. This occasion was planned to allow the projectionist to make his contribution to the great success of this exposition, but we also hope that it will enable the public to more fully realize the important part the projectionist plays in the motion picture industry.

"I wish to thank all who have helped make Projectionist Day a success through their active participation, and also express my appreciation of the encouragement we have received from the large number of I. A. Locals who have either sent a representative to be present today, have written to us, or wired, expressing their approval of this event."

The Fundamentals of Mathematics

By *GEORGE LOGAN*

SOUND DEPARTMENT, METRO-GOLDWYN-MAYER STUDIOS

IV. Simultaneous Equations.

It will be a help if the reader digest each article as it appears, for the ideas presented in subsequent sections hinge upon an understanding of topics discussed in earlier sections. Further, it is desirable that the issues of this series be cached away after reading, as back-reference may be useful before the series is completed.

IT IS worth while to make a study of the methods used in solving simultaneous equations, for in the methods to be discussed we must necessarily use most of the various fundamental operations which have been established in the three previous sections of this series. In brief, we'll get a good review in the handling of equations. Also, they often crop up in practical problems of mechanics and electricity. As a case in point, a simultaneous equation solution of a branched circuit is included at the end of this article.

Simultaneous equations are two or more independent equations involving the same unknowns. Thus, if a and b are the unknowns, two simultaneous equations involving these unknowns could be:

$$4a+3b = 6$$
$$2a-b = 4$$

It is evident that these equations are independent, because they express *different* relations of the unknowns. But suppose we have:

$$4a+3b = 6$$
$$8a+6b = 12$$

These equations, it is apparent, are not independent, for if we multiply both sides of the first equation by 2, the second equation is obtained. Hence the second equation can be reduced to identity with the first equation simply by dividing both sides of the second equation by 2; and therefore the second equation is not independent of the first equation.

If we have but one equation in two unknowns, such as:

$$4a+3b = 6$$

it is possible to find an infinite number of values for each of the two unknowns which will make the equation true; that is, satisfy it. This can be easily shown by arbitrarily setting values for one unknown and then computing the other. If in the equation immediately above we assign various values to a:

$$\text{if } a = \tfrac{1}{2}, \therefore b = 1\tfrac{1}{3}$$
$$a = 1, \therefore b = \tfrac{2}{3}$$
$$a = 2, \therefore b = -\tfrac{2}{3}$$
$$a = 3, \therefore b = -2$$

and so on indefinitely.

But if we have two simultaneous equations involving two unknowns, there is possible only one value for each of the unknowns. In other words, if we have two simultaneous equations involving a and b, there is only one value for a and only one value for b which will satisfy both equations. When that one possible value for each of the unknowns is found the simultaneous equations are solved.

To reach the solution operations are performed on the equations so that a single equation is derived from them involving just one unknown. This process is called *elimination*, quite naturally, for in this single derived equation all but one unknown are eliminated. Any one of several means of elimination may be used, according to which means is most conveniently applied to a given problem. The several means of elimination may be listed:

1. By addition or subtraction of simultaneous equations.
2. By substitution of values.
3. By equating equal expressions.

Each of these operations have the common goal of making all but one unknown disappear, so that a numerical value can be found for that one unknown. Let us consider the first method listed.

1. *Elimination by addition or subtraction of simultaneous equations.*

Assume that we have the appended simultaneous equations Nos. 1 and 2.

$$1. \quad 4x+3y = 6$$
$$2. \quad 4x-3y = 18$$

Inspection shows that if we add Nos. 1 and 2 the resultant equation, No. 3, will not have a y term.

$$1. \quad 4x+3y = 6$$
$$2. \quad \underline{4x-3y = 18}$$
$$3. \quad 8x = 24$$

Solve for x from No. 3:

$$3. \quad 8x = 24$$
$$x = \frac{24}{8}$$
$$x = 3$$

Thus from addition of our simultaneous equations we eliminate one of the unknowns, y, and obtain a value for the other unknown, x. Now to find the value of y, simply place $x = 3$ in either No. 1 or No. 2.

$$1. \quad 4x+3y = 6$$
$$(4)(3)+3y = 6$$
$$12+3y = 6$$
$$3y = 6-12$$
$$3y = -6$$
$$y = -2$$

Hence the solution of Nos. 1 and 2 is $x = 3$ and $y = -2$. To check for correctness, place these determined values in No. 2:

$$2. \quad 4x-3y = 18$$
$$(4)(3)-(3)(-2) = 18$$
$$12+6 = 18$$
$$18 = 18 \text{ check}$$

We can take this same problem and solve it by subtracting the simultaneous equations. Subtract equation No. 2 from equation No. 1:

$$1. \quad 4x+3y = 6$$
$$2. \quad \underline{4x-3y = 18}$$
$$6y = -12$$
$$y = -2$$

Place $y = -2$ in equation No. 1:

$$1. \quad 4x+3y = 6$$
$$4x+(3)(-2) = 6$$
$$4x-6 = 6$$
$$4x = 12$$
$$x = 3$$

It is apparent that to eliminate an unknown through addition or subtraction of simultaneous equations, the coefficient for that unknown must be numerically the same in each equation. Equation Nos. 1 and 2 comply with this requirement as they stand—that is, the coefficient of x is numerically 4, and the coefficient of y is numerically 3, in both equations.

Discretion as to whether we use addition or subtraction depends on the signs of the equal coefficients. If in two equations the coefficients of an unknown are equal and of *opposite* sign, addition will make the unknown disappear. If in two equations the coefficients of an unknown are equal and of the *same* sign, subtraction will eliminate the unknown.

We know that we can multiply both sides of any equation by any chosen

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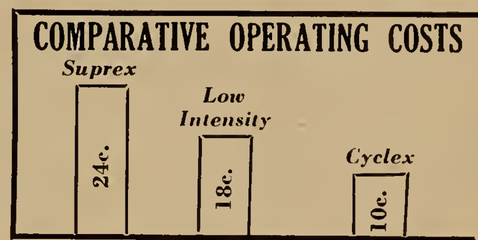

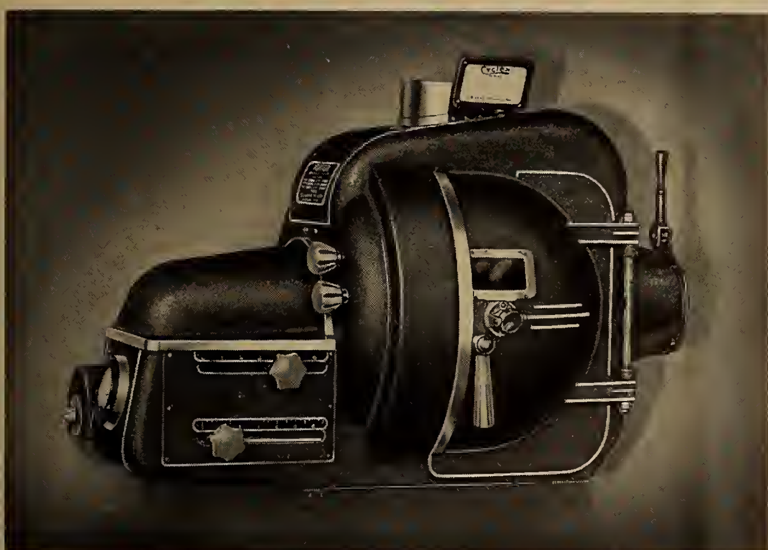

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number without changing the equation's value, and we also know that we can divide both sides of any equation by any chosen number without changing the equation's value. In such operations we of course change the magnitude of individual coefficients.

Thus when we are presented with simultaneous equations which do not have equal coefficients for some unknown which we wish to eliminate, we simply multiply or divide one or both equations by chosen numbers so that equal coefficients for the particular unknown are formed in both equations. Consider the appended simultaneous equations Nos. 1 and 2:

$$\begin{aligned} &1. \quad 3x+7y = -23 \\ &2. \quad 2x+\ y = \quad 3 \end{aligned}$$

We note that we can cause the coefficient of x to be 6 in both equations if we multiply equation No. 1 throughout by 2, and No. 2 throughout by 3. We can then eliminate by subtraction:

$$\begin{aligned} \text{No. } 1\times 2. \quad 6x+14y &= -46 \\ \text{No. } 2\times 3. \quad \underline{6x+\ 3y} &= \underline{\quad 9} \\ 11y &= -55 \\ y &= \ -5 \end{aligned}$$

Place $y = -5$ in equation No. 2:

$$\begin{aligned} 2x+y &= 3 \\ 2x+(-5) &= 3 \\ 2x-5 &= 3 \\ 2x &= 3+5 \\ 2x &= 8 \\ x &= 4 \end{aligned}$$

Thus $x = 4$ and $y = -5$ is the solution. For a ready check, place these values in equation No. 1. If these values satisfy equation our solution is correct.

$$\begin{aligned} 1. \quad\quad 3x+7y &= -23 \\ (3)(4)+(7)(-5) &= -23 \\ 12+(-35) &= -23 \\ 12-35 &= -23 \\ -23 &= -23 \text{ check} \end{aligned}$$

Appended hereto is another example, this one showing how an equation may be divided throughout by a number so that we can proceed with a solution by addition:

$$\begin{aligned} 1. \quad\quad 21x+7y &= 336 \\ 2. \quad\quad -3x+\ y &= \quad 6 \end{aligned}$$

Divide No. 1 by 7, and add equation No. 2:

$$\begin{aligned} 3x+\ y &= 48 \\ \underline{-3x+\ y} &= \underline{\ \ 6} \\ 2y &= 54 \\ y &= 27 \end{aligned}$$

Place $y = 27$ in equation No. 2:

$$\begin{aligned} -3x+\ y &= 6 \\ -3x+27 &= 6 \\ -3x &= 6-27 \\ -3x &= \ -21 \\ x &= 7 \end{aligned}$$

To check, place $x = 7$ and $y = 27$ in equasion No. 1:

$$\begin{aligned} 21x+7y &= 336 \\ (21)(7)+(7)(27) &= 336 \\ 147+189 &= 336 \\ 336 &= 336 \text{ check} \end{aligned}$$

2. *Elimination by substitution of values.*

In this method we take one of the equations and transpose terms until we obtain an expression for one of the unknowns. We substitute this expression in the *other* equation. By this substitution one of the unknowns is eliminated in the other equation. This will be clarified if we work out an actual example. Consider the appended simultaneous equations Nos. 1 and 2:

$$\begin{aligned} &1. \quad\quad x+2y = 10 \\ &2. \quad\quad 2x+\ y = \ 8 \end{aligned}$$

Solve for x from equation No. 1:

$$x = 10-2y$$

Substitute this value of x in equation No. 2 and simplify:

$$\begin{aligned} 2x+\ y &= 8 \\ 2(10-2y)+y &= 8 \\ 20-4y+\ y &= 8 \\ -3y &= 8-20 \\ -3y &= \ -12 \\ y &= 4 \end{aligned}$$

Place $y = 4$ in equation No. 2:

$$\begin{aligned} 2x+y &= 8 \\ 2x+4 &= 8 \\ 2x &= 8-4 \\ 2x &= 4 \\ x &= 2 \end{aligned}$$

To check, place $y = 4$ and $x = 2$ in equation No. 1:

$$\begin{aligned} x+2y &= 10 \\ 2+(2)(4) &= 10 \\ 2+8 &= 10 \\ 10 &= 10 \end{aligned}$$

Appended is the solution of another example using the substitution method, but this time we have omitted most of the interpretative phrasing on the sidelines. It will be good practice to follow through the steps for yourself without benefit of cues.

$$\begin{aligned} 1. \quad\quad 3x-4y &= -3 \\ 2. \quad\quad 4x+\ y &= \ \ 15 \\ 3x &= -3+4y \\ x &= \frac{-3+4y}{3} \end{aligned}$$

$$\begin{aligned} 2. \quad\quad 4x+\ y &= 15 \\ 4\left(\frac{-3+4y}{3}\right)+\ y &= 15 \\ \frac{-12+16y}{3}+\ y &= 15 \end{aligned}$$

(Hint: multiply throughout by 3 to clear the fraction):

$$\begin{aligned} -12+16y+3y &= 45 \\ 19y &= 45+12 \\ 19y &= 57 \\ y &= \ \ 3 \end{aligned}$$

$$\begin{aligned} 2. \quad\quad 4x+y &= 15 \\ 4x+3 &= 15 \\ 4x &= 15-3 \\ 4x &= 12 \\ x &= \ \ 3 \end{aligned}$$

$$\begin{aligned} 1. \quad\quad 3x-4y &= -3 \\ (3)(3)-(4)(3) &= -3 \\ 9-12 &= -3 \\ -3 &= -3 \text{ check} \end{aligned}$$

Hence: $x = 3$, $y = 3$

Let's apply this substitution method to a practical problem. A gun was fired, and the speed of the sound with the wind was 1070 feet per second, and 1030 feet per second against the wind. Find the velocity of sound in still air and the velocity of the wind.

We have two unknowns, which we shall call x and y.

Let x = velocity of sound in still air.

Let y = velocity of the wind.

The measured velocity, 1070 feet per second, represents the velocity of sound in still air plus the velocity of the wind: $x + y = 1070$.

The measured velocity, 1030 feet per second, represents the velocity of sound in still air minus the velocity of the wind: $x - y = 1030$.

Hence our simultaneous equations are:

$$\begin{aligned} &1. \quad\quad x+y = 1070 \\ &2. \quad\quad x-y = 1030 \end{aligned}$$

Solving these by the substitution method:

$$x = 1030+y$$

$$\begin{aligned} 1. \quad\quad x+\ y &= 1070 \\ (1030+y)+\ y &= 1070 \\ 1030+2y &= 1070 \\ 2y &= 1070-1030 \\ 2y &= 1040 \\ y &= 20 \text{ ft. per sec.} \end{aligned}$$

$$\begin{aligned} 2. \quad\quad x-\ y &= 1030 \\ x-20 &= 1030 \\ x &= 1030+20 \\ x &= 1050 \text{ ft. per sec.} \end{aligned}$$

$$\begin{aligned} 1. \quad\quad x+\ y &= 1070 \\ 1050+20 &= 1070 \\ 1070 &= 1070 \text{ check} \end{aligned}$$

3. *Elimination by equating equal expressions.*

In this method we take one of the equations and transpose terms until we obtain an expression from one of the unknowns. Then we take the other equation and transpose terms until we

obtain an expression for the same unknown. We equate these two equivalent expressions to each other. By this equating an unknown is eliminated. An actual example will clarify this procedure. Consider the appended simultaneous equations Nos. 1 and 2:

$$1.\quad 6x-2y = 10$$
$$2.\quad 4x+y = 16$$

Solve for x from equation No. 1:

$$6x-2y = 10$$
$$6x = 10+2y$$
$$x = \frac{10+2y}{6}$$

Solve for x from equation No. 2:

$$4x+y = 16$$
$$4x = 16-y$$
$$x = \frac{16-y}{4}$$

Thus we have obtained two expressions

$$\frac{10+2y}{6} \text{ and } \frac{16-y}{4}$$

both of which are equal to x. Hence they are equal to each other.

$$\therefore \frac{10+2y}{6} = \frac{16-y}{4}$$

Cross-multiply to clear fractions and simplify:

$$4(10+2y) = 6(16-y)$$
$$40+8y = 96-6y$$
$$6y+8y = 96-40$$
$$14y = 56$$
$$y = 4$$

Place $y = 4$ in equation No. 2:

$$4x+y = 16$$
$$4x+4 = 16$$
$$4x = 16-4$$
$$4x = 12$$
$$x = 3$$

To check, place $x = 3$ and $y = 4$ in equation No. 1:

$$6x-2y = 10$$
$$(6)(3)-(2)(4) = 10$$
$$18-8 = 10$$
$$10 = 10 \text{ check}$$

Hence $x = 3$ and $y = 4$ is the correct solution.

When there are two unknowns, as is the case in each of the examples thus far worked out, two equations are needed to reach a solution. If there are three unknowns, three independent equations are needed; if four unknowns, four independent equations are needed, and so on. Regardless of how many unknowns and equations are involved, however, the unknowns are ultimately found by using any or all of the methods we have just outlined.

We shall conclude this article by working out a practical problem involving three unknowns, requiring the set-up of three simultaneous equations and the solution of the same. The steps by which this problem is solved will be particularly informative since they require application of most of the important ideas we have established in previous articles of this series—signs, factors, multiplication, division, addition, subtraction—as well as application of methods 2 and 3 for simultaneous equations.

In this problem we have given the circuit shown in Fig. 1, with constants as indicated. We are to find by solution of simultaneous equations the values of I_1, I_2, and I_3, the currents in each of the three branches. The currents are our three unknowns. (This problem could be solved, of course, by the possibly more familiar method whereby we compute the resistance equivalent to R_2 and R_3 in parallel—but our purpose here is to illustrate solution by simultaneous equations.)

Certain things are known about this circuit which will enable us to set up three independent equations. The voltage across a—b is common to each branch:

$$E-I_1R_1 = I_2R_2$$
$$I_2R_2 = I_3R_3$$

And the total current flowing through R_1 is equal to the sum of the currents flowing in R_2 and R_3:

$$I_1 = I_2+I_3$$

Collecting equations and substituting known constants:

$$1.\quad 20-5I_1 = 10I_2$$
$$2.\quad 10I_2 = 15I_3$$
$$3.\quad I_1 = I_2+I_3$$

Substitute value for I_1 from equation No. 3 in equation No. 1:

$$1.\quad 20-5I_1 = 10I_2$$
$$20-5(I_2+I_3) = 10I_2$$
$$4.\quad 20-5I_2-5I_3 = 10I_2$$

Solve for I_2 from equation No. 4. Use transposition, factoring, and then simplify:

$$4.\quad 20-5I_2-5I_3 = 10I_2$$
$$-5I_2-10I_2 = -20+5I_3$$
$$-15I_2 = -5(4-I_3)$$
$$I_2 = \frac{-5(4-I_3)}{-15}$$
$$5.\quad I_2 = \frac{4-I_3}{3}$$

Solve for I_2 from equation No. 2:

$$2.\quad 10I_2 = 15I_3$$
$$I_2 = \frac{15I_3}{10}$$
$$6.\quad I_2 = \frac{3I_3}{2}$$

Equate the expressions for I_2 and simplify

$$\frac{4-I_3}{3} = \frac{3I_3}{2}$$
$$2(4-I_3) = 3(3I_3)$$
$$8-2I_3 = 9I_3$$
$$-2I_3-9I_3 = -8$$
$$-11I_3 = -8$$
$$I_3 = \frac{-8}{-11}$$
$$7.\quad I_3 = \frac{8}{11} \text{ amps.}$$

Substitute value of I_2 from equation No. 7 in No. 6:

$$6.\quad I_2 = \frac{3I_3}{2}$$
$$I_2 = \frac{3}{2}\times\frac{8}{11}$$
$$I_2 = \frac{24}{22}$$
$$8.\quad I_2 = 1\tfrac{1}{11} \text{ amps.}$$

Substitute values of I_2 and I_3 from equation Nos. 8 and 7 in No. 3:

$$3.\quad I_1 = I_2+I_3$$
$$I_1 = 1\tfrac{1}{11}+\tfrac{8}{11}$$
$$9.\quad I_1 = 1\tfrac{9}{11} \text{ amps.}$$

As a check, substitute numerical values of I_1 and I_2 in equation No. 1:

$$1.\quad 20-5I_1 = 10I_2$$
$$20-5(1\tfrac{9}{11}) = 10(1\tfrac{1}{11})$$
$$20-5(\tfrac{20}{11}) = 10(\tfrac{12}{11})$$
$$220-100 = 120$$
$$120 = 120 \text{ check}$$

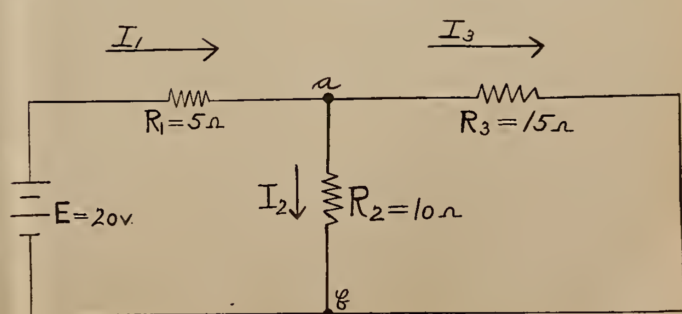
Hence:

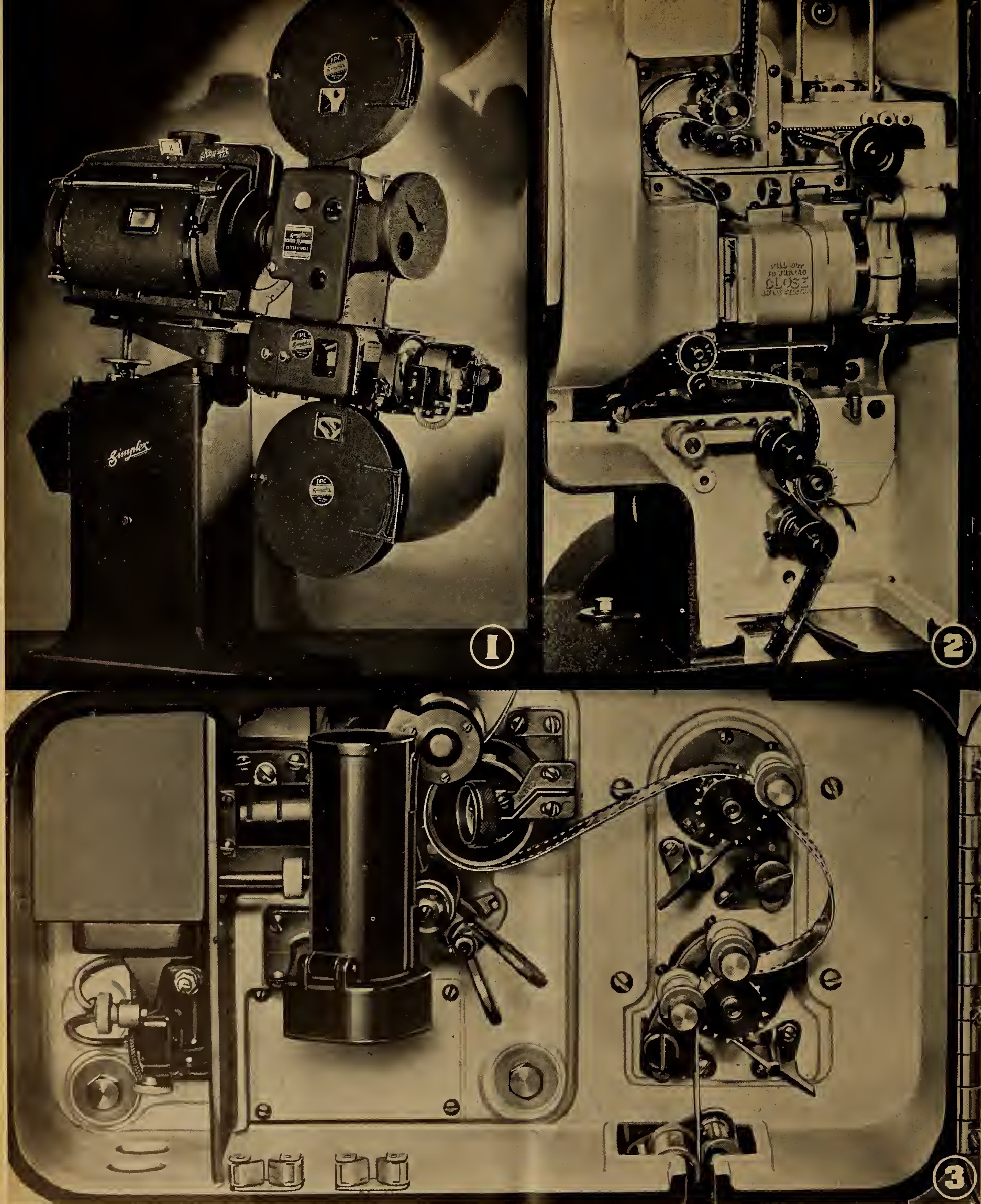
$$I_1 = 1\tfrac{9}{11} \text{ amps.}$$
$$I_2 = 1\tfrac{1}{11} \text{ amps.}$$
$$I_3 = \tfrac{8}{11} \text{ amps.}$$

This solution may appear quite lengthy and involved, but that is because each step has been set down in detail. After one becomes skilled in the method many of the intermediate steps may be shortened or omitted to attain the same result.

(TO BE CONCLUDED)

FIGURE 1





Graphic Story of New Simplex SI Equipment

1. Engineered as a complete visual-sound projection unit and featuring a new lamp and new base. 2. Film projection head, showing film path. Semi-automatic lubrication—no pump. Intermittent and upper drive units operate in a bath of fluid oil. Air deflector and cooling fins in combination cool film trap and gate. 3. Sound head is the same as that used in Simplex 4-Star system.

Inclusive Simplex SI Equipment For 200-800 Seat Range Theatres

THE new Simplex SI mechanism has been designed, manufactured and priced to supply definite demand for projection equipment which will provide better sound and visual projection for moderate size theatres with a seating capacity ranging from 200 to 800 seats. Although moderately priced, the new SI mechanism will give very satisfactory results in the special field for which it is intended. It will enable the theatre owner who has been compelled to use old, worn-out and obsolete equipment, to purchase standard Simplex equipment at a price that compares with the low-priced inferior equipment now in use.

This new SI mechanism has many of the latest and most modern improvements, such as front- and rear-shutters, semi-centralized lubrication, air deflector and aperture cooling unit, sprocket strippers of the non-wrap-around type, fire shutter safety trip of advance design, and also has many other proven Simplex advantages.

"Hunting-type" gears in the gear train of the SI mechanism have proved very efficient over a long period in other Simplex equipment. This type of gear has an uneven number of teeth, which means that the same teeth do not continue to mesh as the gear revolves. Each tooth in the gear meshes with every other tooth on the mating gear in the course of several revolutions, and this results in an even distribution of wear, prevents the development of high or low spots, and is an increased assurance of quiet performance.

Furthermore, with hunting-type gears it is unnecessary to mark for an exact tooth when the gears are removed temporarily, and they do not have to be put back in mesh in a certain way. The gears are simply slipped onto their shafts without any regard as to which tooth meshes with another. This, of course, materially reduces maintenance and repair.

Gear Train, Intermittent

The SI mechanism is entirely gear driven, but there has been a simplification of the drive, and fewer parts are used than in any gear train which has been employed heretofore in a Simplex professional mechanism. The shutter shaft upper sprocket assembly and intermittent drive assembly are an integral unit. Operating parts are in an oil-type case and operate in an oil bath. Certain dimensional changes have been made in the intermittent movement, but the design is essentially the same as that which has long given thoroughly satisfactory results. The intermittent is completely enclosed, operates in an oil bath, and has long proved that it will stand up under hard grinds.

Framing knobs project from either side of the mechanism; in framing, the entire upper drive unit and intermittent assembly move forward or backward as a unit, while the gate and film trap remains stationary, and only a slight change in the loop length brings the picture into frame when this is required.

The lower sprocket idler assembly can be mounted in either of two positions to correctly align the mechanism with any type of sound head currently available, by means of two bosses which are provided in the main frame. The gate and film trap assembly is of simplified design which has been thoroughly tested in long practical use and has proved particularly satisfactory where warped film is encountered.

Semi-Automatic Lubrication

Although lubrication of the mechanism is semi-centralized, in addition to the gear train, several separate points are provided for parts that require attention from time to time. A special composition is used throughout for bearings and these, being of the self-lubricating type, ordinarily will need no attention. As an additional protection, adequate lubrication is assured by feeding oil to the outer circumference of these bearings, which is absorbed by the bearings and released as required. The level of the lubricant in the upper oil chamber and intermittent oil chamber can be readily seen through the glass windows.

Another feature of this mechanism is the new air deflector and aperture cooling unit now manufactured as an attachment or an integral part of the finest Simplex projectors. This unit does four jobs: steadies the light; reduces the heat at the aperture; prevents lamphouse carbon dust and dirt from being drawn into the mechanism, and prevents drawing of gases from the arc lamp into the projection room.

The automatic fire shutter, an important safety factor, operates in the following manner: Should the film for any reason remain stationary at the aperture, the upper loop enlarges above the aperture plate and lifts a curved tripper piece which instantly releases the fire shutter so that absolutely no light reaches the film.

"So this is what you call a 'ground'"

Framing and focusing knobs may be manipulated from either side of the mechanism, and a framing light is provided which enables threading in frame without difficulty regardless of the density of the film. This is accomplished by means of a reflector mounted on a fire shutter which reflects a beam of light through the aperture from behind.

To increase visibility and encourage cleanliness, the interior of the operating side is finished in white enamel. Lubrication points are conspicuously marked in red. All major assemblies are attached to an auxiliary support casting, which in turn is rigidly mounted on the mechanism casing—making it a very simple matter to remove assemblies for inspection or repair.

The new SI pedestal will permit many theatres to discard the three- or five-point pedestals designed many years ago to support the rather flimsy projection and lamphouse equipment then in use, even before better sound equipment was introduced as an additional burden. The new SI pedestal provides a rigid, sturdy base which is adequate for modern mechanisms, lamphouses, sound heads and magazines.

Pedestal and Lamphouse

The pedestal is a vibration-proof base which gives an additional assurance of steadiness on the screen. It is designed somewhat along the lines of the heavier and more expensive models, has a built-in hand-wheel and lock nut adjustment for obtaining the correct angle, and is also provided with sufficient adjustment to accurately align the projection lamp. Allen headless-adjusting screws provided for the four corners of the base permit the equipment to be easily aligned, regardless of any irregularities in the room floor. Some economies have been effected by the elimination of lateral adjustment devices used on other Simplex bases, but the SI pedestal has retained many features of the higher-priced equipment, such as space for installing all wiring in the base itself, adequate plug-in receptacles, and a 100-ampere switch and switch box accessible from either side of the projector. The removal of a latch door allows the projectionist or installation engineer easy access for connecting or disconnecting the several electric circuits. The pedestal weighs 225 pounds.

The new Simplex low intensity lamp is of advanced design, sturdy and roomy, employing exceptionally large eliptical reflector, 11⅜". It has an automatic ball-bearing arc control motor, ammeter with illuminated scale, arc imager and means for quickly striking the arc. It is equipped with inside dowser which operates from either side of the lamphouse, and a removable ash tray.

Flicker In Motion Pictures†

LORIN D. GRIGNON
PARAMOUNT PICTURES, INC.

Flicker in motion pictures has been receiving attention ever since the beginning of the art, and most of the sources of this defect have been minimized, if not eliminated, by technical accomplishments. The paper constitutes a qualitative review of the now prevalent sources of flicker, presenting some new concepts, emphasizing the sources of major importance at the present time, and reporting on two investigations made on the problem. Flicker and "registration jump" are differentiated, and the latter, which is really a separate problem, is not considered. Some data are presented to indicate the magnitude and characteristics of the flicker effect.

CONSTANT efforts have been directed in the technical branches of motion picture production and exhibition toward the removal of effects which make the mechanical processes in pictures obvious to the observers and detract thereby from the realism and entertainment value. Aside from features such as camera angle, lighting, sets, backgrounds, sound, *etc.*, two completely mechanical effects in pictures can cause serious loss of entertainment value. These two are flicker and registration.

This paper does not propose to discuss registration; therefore it is necessary to differentiate this effect from that of flicker. Briefly, registration is an irregularity in the *position* of successive picture frames on the film or screen. Flicker is an irregularity between successive frames in the total amount of reflected light from the screen, other than that purposely created, from a given scene.

Many Sources of Flicker

Flicker still is an important problem in the industry, although the serious defects are intermittent in nature. Flicker is due not only to the frame frequency (24 per second) but also is the result of other variations superimposed upon the frame frequency. This latter effect can be considered in the same light as flutter in sound recording and reproducing. This paper will lay the greatest stress on these harmful superimposed variations.

Consider now the many sources of flicker, and group them as follows for later consideration:

(*A*) *Original Photography*:
(1) Set lighting (2) Negative film (3) Irregular camera motion, including motor system (4) Development.
(*B*) *Printing*:
(1) Lamp irregularity (2) Positive (3) Printer motion (4) Development.
(*C*) *Projection*:
(1) Arc flicker (2) Intermittent shutter (3) Projector mechanics.
(*D*) *Background Projection*:
(1) All of *A* (2) All of *B* (3) All of *C*.

†J. Soc. Mot. Pict. Eng., XXXIII (Sept. 1939).

With so many possible sources of flicker it is very easy to understand how flicker may easily occur. Also, although each of the above might be small in absolute value, in instances when two or more occur at the proper frequencies and phase relationships the effect becomes pronounced. This likewise accounts for the difficulty in tracing, separating, and minimizing the major sources.

Two analyses and invesigations made at the Paramount Studios disclosed four important facts:

First, considerable change in reflected light can be tolerated by the observer provided this change occurs at random intervals which are not closely spaced or of excessive duration. The moment the light change become cyclic, the amount of tolerable difference decreases sharply to a surprisingly small value.

Second, the rate at which the cyclic flicker occurs determines the amount of disturbance to the observer. No accurate determinations of this fact have been made. However, the rate of maximum disturbance appears to be between 6 and 8 cycles per second. Fig. 1 shows an approximate curve representing the apparent disturbing effect versus the rate of flicker.

Third, the change in transmission for perceptible periodic flicker occurring at the greatest disturbing rate of 6 to 8 cycles is about 3 per cent. The greater the change in transmission the greater the effect.

Fourth, the disturbing effect is related to the amount of light. The greater the intensity the more obvious the defect.

We shall now discuss the various sources of flicker, some briefly and others in more detail.

(*A*) *Original Photography.*—The first cause of flicker in this group occurs in the set lighting. The intensity changes of incandescent lamps are of a relatively slow and random nature, and cause changes in the average brilliance of the scene and are dependent upon the regulation and stability of the power supply. Arc lamp flicker is more likely to be cyclic and therefore of a more serious nature. Arc lamp flicker generally resolves into slow periodic changes such as line-voltage and carbon-rotation effects and very fast random fluctuations. The very rapid fluctuations cause the most trouble in background process work, while the slow variations can cause serious trouble on split-screen shots. This is acknowledged and must be solved by the lamp and carbon manufacturers.

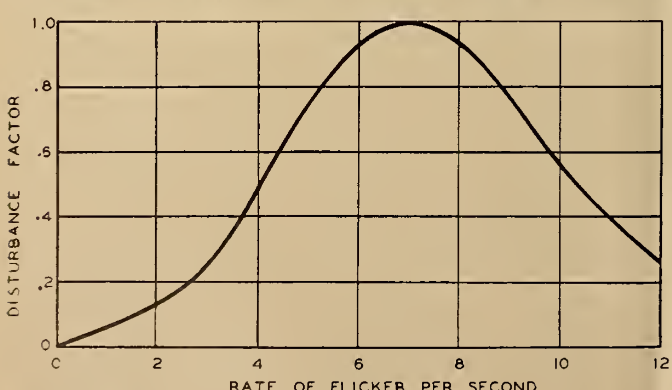


FIGURE 1
Showing the apparent disturbing effect of cyclic flicker as compared with rate of flicker

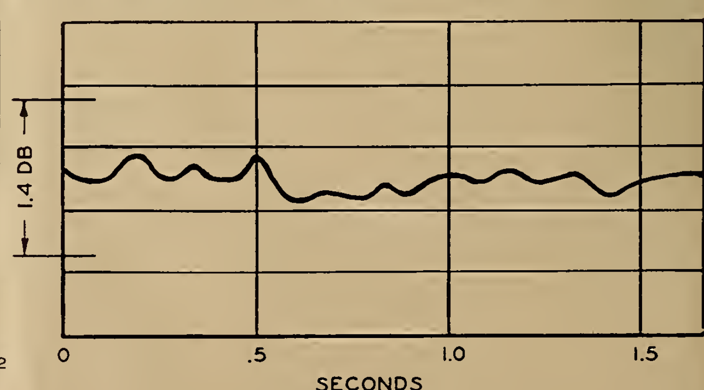


FIGURE 2
Chart of picture negative in which photographic flicker is just perceptible, representing about 3% in transmission

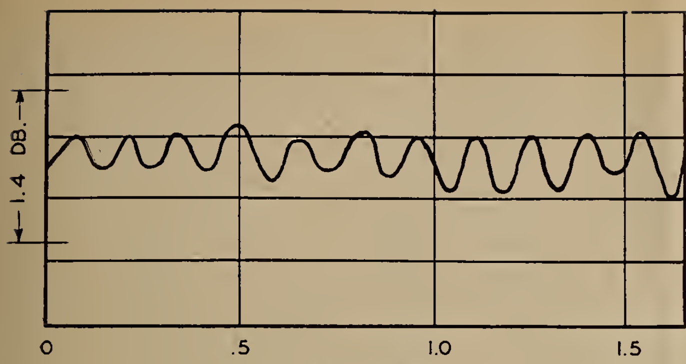


FIGURE 3

Chart showing objectionable flicker amounting to about 8 to 10% variation in transmission

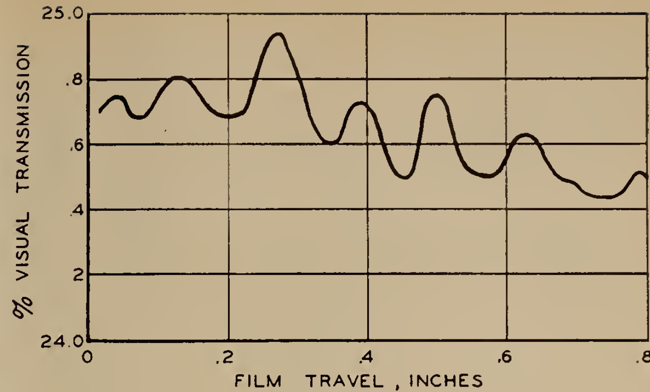


FIGURE 4

Flicker due to printing: transmission change caused by a ripple voltage of 10 to 15%

Negative film is known to have random changes in sensitivity, and some stocks have cyclic changes occurring at at a rate of one cycle in 7 to 12 seconds, at a speed of 90 feet per minute. These variations are not in themselves too serious, but should they fall in phase with other cyclic changes, then the resulting flicker would be noticeable. Stocks having cyclic and random sensitivity have been submitted for use. In general these defects have been minimized.

● Irregular Camera Motion

Irregular camera motion is one of the worst offenders at present, but the motor system is not blameless and can be the cause of flicker. For some time the interlock motor system, when used, was condemned for all this trouble; the fact is that the interlock motor system was not the source, but its basis of operation allowed the trouble to persist and frequently amplified it.

It would appear that, to obtain a steady exposure, the speed of the rotating shutter, which exposes the film, should be as smooth and constant as the movement of film through a sound recorder. A great deal of time and money has been spent by sound equipment manufacturers and users to reduce flutter, and, as previously mentioned, picture flicker is nothing more than flutter. However, cameras generally use a slipping belt directly coupled to the shutter shaft for a film take-up mechanism. Belt condition greatly influences the steadiness of take-up, and each instant that a sudden change in load occurs the motor system reflects that change.

Even with a motor having no resilience, changes in load can cause flicker. The camera undoubtedly contains mechanical inductances and capacities (which would include the shutter, motor rotors, gears, backlash, motor air-gap, flux, *etc.*) that can become resonant. Even though these reactances are inherently stable, the system might be thrown into oscillation by a sudden shock of small magnitude. This is evidenced by circumstances that have occurred when belt condition, mechanical looseness, and shutter action have all combined to become oscillatory and persistent at a rate well within the greatest disturbing region of Fig. 1.

It was while working on a new motor system in conjunction with Erpi that a full realization of the true nature of the difficulty was reached. A few clutches have been tried that gave varying degrees of improvement but none completely solved the problem. Fig. 2 shows a chart of a section of picture negative in which the flicker was just perceptible, representing about 3% variation in transmission. Fig. 3 shows a similar chart having flicker amounting to about 8% to 10% variation in transmission.

Those who have never seen the action of a camera shutter might observe the opening or closing edge of the shutter with a stroboscope, which is accurately synchronized with the motor, as either of these edges pass the aperture. Obviously, any variation in the shutter while it is fully open will have no deleterious effects.

Development of negative is suspected of causing some variations, but no conclusive data are yet available. It should not be deduced, however, that the laboratory is entirely faultless.

(*B*) *Printing.*—When the printer light is supplied from a generator or rectified alternating current, sufficient filtering must be used to reduce intensity changes to a small value. The ripple voltage should be less than 1 per cent. It is true that the normal ripple frequencies are beyond the greatest disturbing flicker rate, but the existence of 120 cycles in conjunction with other flicker frequencies produces a creeping density pattern in the projected picture. Frequencies increasingly higher than 120 cycles would undoubtedly cause less and less trouble. This particular effect is greatly dependent upon the amount of light and the density of the various parts of the scene. It becomes most apparent in scenes including dark skies such as in night shots made with filters in the daytime. Fig. 4 shows the transmission change caused by a ripple voltage of 10 to 15 per cent.

Periodic flicker has been traced to printer motion on an earlier type of machine, but no data exist on machines of current manufacture. In the case under investigation the flicker was caused by the belt splice which created created periodic film-speed changes as the stock passed the aperture; *i.e.*, as the belt splice passed over the pulley the effective radius of the pulley was changed, causing a corresponding film-speed variation. Fig. 5 shows this effect under two conditions, that of normal

FIGURE 5

Flicker effect in printing, due to belt splices

operation and with an exaggerated splice. Only the amplitude of the variations has changed; the rate having remained fixed.

Print development, the same as in negative development, has been suspected of some trouble since, of two prints from the same negative, one may have flicker and the other not. It is true that the printer itself may cause this trouble but no analysis has been made.

(*C*) *Projection.*—The whole subject of background projection has been well covered by the work of the Academy Research Council Process Projection Equipment Committee[1] under the chairmanship of Farciot Edouart, and a great number of the conclusions arrived at apply to projectors in general.

The first item of particular importance in projection is steadiness of the arc lamp. This factor has been appreciated for some time and efforts have been directed toward its reduction. The work done by the aforementioned Committee has further advanced arc lamp technic.

● Projector Shutter Flicker

Shutter flicker in projection is still an important problem and resolves into two separate factors. First, constancy of light from frame to frame of a particular scene; mechanical accuracy of all parts; lack of mechanical resonances; and a stiff or non-resilient and well damped motor-drive will all contribute to improvement. Shutter variations amounting to 7 degrees have been observed.

Second, the effects of shutter rate and the manner of eclipsing the picture must be considered. The minimum rate is established by the frame frequency. During the period that the shutter is open a still picture is being projected, but it is possible to demonstrate a reduction in flicker by interrupting this still picture for a short interval of time by an additional blade. This, of course, essentially increases the frame frequency but leads further to the possibility of other physiological factors.

The question of two-bladed *versus* four or more bladed shutters of various dimensions, and one-sided or two-sided wipes, is certainly worthy of investigation. Undoubtedly the best approach to a real solution is by an extensive series of studies. These tests should be made by projecting a single frame or still picture at an intensity equalling that of the good theatre picture and always maintaining the same average amount of light on the screen regardless of shutter design. Further, these tests should include various values of eclipsing times from zero up, with all the darkness occurring in one interval and the same total amount of darkness broken up into two or more intervals, single *versus* double wipes, and instantaneous *versus* dissolving wipes. After reaching a definite conclusion for the most satisfactory combination, various periodic rates of irregularity could be superimposed upon the shutter action to obtain more definite and scientific data on this particular flicker effect.

(*D*) *Background Projection.*—Background projection suffers from all the aforementioned ailments except one, with the additional penalty of having all defects increased two-fold under certain circumstances. The one exception is shutter flicker in the background projector, and this can be eliminated only by careful synchronization and by making either the camera shutter or projector shutter sufficiently greater than the other so that the irregularities of the two will not overlap. If the synchronism does not remain accurate, overlapping causes a disastrous result.

The author appreciates that all the matters discussed in this paper are controversial, particularly when so little concrete evidence can be presented; but certainly enough is on hand to indicate that progress along this line of endeavor should be stimulated. Much work remains to be done, and this work must be coordinated in such a manner that all persons involved in the final result on the screen work toward the same end. Like so many problems in a complex art, it will not do much good for one branch to assume that its contribution is commercially sufficient. Taken by itself it might be, but when put in combination with other units to form the complete system, the final result may not be good, due to additive effects.

The purpose of this paper has been to call the industry's attention once again to this serious problem, to indicate present major sources of difficulty, and to discuss them in a limited manner; and also to offer whatever assistance our results may provide to those who are qualified and equipped to carry out further studies.

Discussion:

MR. MORGAN: Why is it that flicker has now become such a problem? Have we always had flicker and not noticed it, or have we been adding small distortions to the photographic processes so that they now add up to make a noticeable flicker? How do you determine what you say is appreciable flicker? What is the percentage of flicker when you begin to worry about it?

MR. GRIGNON: We, as sound men, are interested in picture problems, first, because we are interested in improving our employer's product; and second the Sound Department is generally connected with the Camera Department through the necessity of interlocking motor drives. For years we have blamed the motor system for most of the causes of flicker but, as pointed out in the paper, we have found that it was not the motor system itself, but generally the type of operation, which permitted the flicker to exist and did nothing to damp it.

The motor system was not faultless, but we did need a new motor system from that standpoint. Flicker has always been in pictures to some extent, but I can not give you a complete answer to that question. Perhaps one of the reasons we notice flicker more easily now is that we are using more brilliancy in projection. With better pictures on the screen it is very definite that there will be an increase in intensity of screen flicker and that it will be more noticeable.

In answer to the last question: the amount of perceptible flicker was determined by having a number of persons observe results of pictures taken under various conditions, and then obtain the average transmission differences of the

(*Continued on page* 24)

[1] "Recommendations on Process Projection Equipment," Research Council of the Academy of Motion Picture Arts & Sciences. *J. Soc. Mot. Pict. Eng.*, XXXII (June, 1939), p. 589.

Film Aging, Wear Tests

Comparative tests of positive film produced in the U. S. S. R. and of DuPont positive film were made, using various projectors, light sources, and sound reproduction systems. The greatest wear was found to occur in the first few projections of both films. The dimensional change of the film per projection was found to decrease as the number of projections increased. The greatest dimensional changes occurred in that part of the film in contact with the projector gate.

In general, the silver density of the film had a considerably greater effect upon the dimensional change of the Soviet film than upon that of the DuPont film, and, in general, the DuPont film was found to have less dimensional change upon repeated projection than the Soviet film. Tests of the resistance of the films to tearing showed that this was not a decisive factor in the useful life of the films. In a study of the plasticity of the two films, it was found that the Soviet film soon became horny and brittle, while the DuPont film largely retained its plasticity throughout its useful life.

The viscosity of one per cent solutions of the DuPont film base in acetone were essentially constant throughout the useful life of the film, showing that only slight structural modification occurred in this film base. Similar tests indicated that considerable structural change was occurring in the Soviet film base. The determining factors in the useful life of a film were found to be the condition of the film perforations and the number of scratches and the amount of dirt present in the film. The Soviet film showed slight gelatin is retained even when the film is subjected to prolonged heating, and that edge-waxing of prints treated by this process is unnecessary for use in the ordinary type of projection machine.—"Aging and Wear of Motion Picture Films in Projection", by L. I. Sazhin and L. R. Varshavskaya. Kino Photo Chem. Ind., pp. 29-39, No. 5, 1938.

S.M.P.E. Convention in N. Y., Oct. 16-19 Lists Varied Papers Program

HOTEL PENNSYLVANIA, New York City, national headquarters of the Society of Motion Picture Engineers, will be the scene of the twenty-fourth annual convention of the Society, to be held Oct. 16 to 19, inclusive. The technical progress which the motion picture industry has made in the past year will be reviewed at the Convention, in many outstanding technical papers presented by the industries' leading engineers and executives.

Local arrangements and reception of Society delegates will be in the hands of an 18-man committee headed by D. E. Hyndman, chairman of the Atlantic Coast Section. Hotel and transportation arrangements are in charge of J. Frank, Jr., and his committee. H. Griffin heads the committee on convention projection. Mrs. O. F. Neu will act as hostess to the ladies, assisted by her Ladies Reception Committee.

One of the principal events of the Convention will be the banquet and dance, to be held Oct. 18 at the Hotel Pennsylvania, when the annual presentations of the Progress Medal and Journal Award will be made. The Progress Medal is awarded annually in recognition of any invention, research or development which has resulted in a significant advance in motion picture technology. The Journal Award is made to the author or authors of the most outstanding paper originally published in the *Journal* of the Society during the preceding calendar year.

● Special Television Showing

Arrangements have been completed for the delegates to witness a special television demonstration at the RCA Exhibit in the New York World's Fair. J. Almonte, director of the exhibit, will be in charge of the demonstration, which will take place after the usual closing hour. Delegates wll also see an exhibit of the latest type of RCA Photophone motion picture sound reproducing equipment which is housed in the same building. The demonstration will be held at 9 p.m. Monday, Oct. 16, the opening day of the convention.

A tentatively scheduled convention feature will be an address of welcome by New York's famous Mayor, F. H. LaGuardia, to be delivered at the informal get-together luncheon.

Abstracts of those papers of particular interest to projectionists are appended hereto:

TELEVISION CONTROL EQUIPMENT FOR FILM TRANSMISSION

R. L. Campbell
Allen B. DuMont Laboratories

A television film chain with particular reference to amplifier, sweep, and power circuits in the film pick-up unit is described. Many improvements in television circuits have been made possible by recent advances in circuits and circuit components in radio and allied electronic fields. Application of some of the newer ideas to motion picture film pick-up equipment has resulted in improved performance and simplicity of operation.

Circuit arrangements which permit flexibility in transmission standards are considered and their application discussed. Also the anticipation of possible future improvements in picture quality is indicated in some circuit capabilities. Simplification of controls from the television projectionist's standpoint is discussed.

SCIENCE AND THE MOTION PICTURE

H. Roger
Rolab Photo-Service Laboratories

The motion picture is a product of science. There is ample historical material available for those who wish to convince themselves of this fact; but a brief review is given of the work of Muybridge and Marey in order to clarify the cause of their inventions. The ensuing discussion centers around the question, "Has science maintained its interest in the motion picture and has it utilized its advantages to its full extent?"

In this paper the word "science" is taken broadly and includes research, dissemination of knowledge, and industrial application. Motion picture's application to science is divided into two distinct categories and are discussed in detail:

(1) The motion picture as an aid to scientific research;

(2) The motion picture as a medium for the dissemination of knowledge.

The paper concludes with descriptions and demonstrations of interesting material from the files of the Rolab Photo-Science Laboratories. Also an inside view is given of production activities of an unusual character.

PRODUCTION OF A THREE-DIMENSIONAL MOTION PICTURE

J. A. Norling
Loucks and Norling

Some problems involved in the production of satisfactory three-dimensional motion pictures have not received much mention in the literature dealing with stereoscopy. Their practical solution has contributed marked improvements to the three-dimensional picture of today.

Fundamental Problem of 'Depth'

The fundamental problem in projecting three-dimensional pictures is that of providing a "right-eye" picture that will reach only the right eye and be prevented from reaching the left eye and, and to do the same for the "left-eye" picture. To attain this result two methods have been employed with success, namely: the "anaglyph" in which substantially complementary colors are employed in the viewing devices, and polarized light.

The screen surface upon which three-dimensional pictures are projected by polarization methods is of extreme importance. The selection of the proper type of screen raises real problems but these also have been overcome in a practical way.

THE PROBLEM OF DISTORTION IN THE HUMAN EAR

S. S. Stevens
Harvard University

The amount of distortion produced by the ear upon a simple sound-wave has been measured by analyzing the electrical output of the ears of animals and by indirect experiments with human ears. The amount of distortion in a sound-wave which the human ear is just able to detect has also been determined, and it is found that the

(*Continued in col. 1, next page*)

I. P. C. E-7 Dual Shutter and Deflector Units Made Available for Super and Regular Simplex Heads

DUE to the success of the Simplex E-7 mechanism brought about in part by the introduction therein of the dual (front- and rear-shutter) assemblies therein, International Projector Corp. has decided to make this major improvement in projection equipment available to users of its earlier models—the Super Simplex and Simplex Regular rear-shutter mechanisms.

● Now Ready for the Field

The assembly for the Super Simplex mechanism is now ready for distribution, the unit for the Regular rear-shutter mechanism will be available shortly. It will be distributed through National Theatre Supply Co. which anticipates a brisk demand from theatres having Simplex mechanisms installed.

This unit provides not only considerably more illumination on the screen but at the same time very definitely improves the quality of the picture presentation brought about by sharpness of definition, reduction of flicker and an illusive something that can best be described as a smoother and pleasanter picture from the observer's point of view.

● Air Deflector Unit

Included in the assembly modernization kit also is another improvement which International introduced at the time the E-7 was placed on the market, the E-75 Air Deflector and Aperture Cooling Unit, which definitely eliminates the possibility of interference with the arc lamp operation and prevents the fluttering of the arc and drawing of gases and carbon dust into the projection room. This latter assembly also provides for more even distribution of light in the projected picture.

The assembly has been so simplified that it may be readily attached to any Super Simplex mechanism in very short time without removing it from its operating position.

threshold of audible distortion is intimately related to the amount of distortion occurring in the ear itself. Hence the transmission characteristics of the ear determine the tolerances for distortion in sound-reproduction.

REPORT OF STANDARDS COMMITTEE

E. K. Carver, *Chairman*

Proposals have been received from the ISA Secretariat for International Standardization of raw-film cores; 16-mm sound-film; projection reels; projection reel boxes; 8-mm film dimensions; and definition and marking of safety film.

Most of these proposals differ from the SMPE standards only in tolerance. Some of the tolerances appear to be unimportant and some important. The European practice for projection reels differs so widely from the American practice that it is deemed impossible to come to an international agreement. Standardization of 16-mm projection reel boxes appears to be outside the range of useful standardization.

35- *and* 16-*mm. Track Dimensions*

The international standard definition of safety film has been cleared up in all points except the question of nitrogen content.

The question of sound-track dimensions for 35-mm and 16-mm film was clarified, to a considerable extent, at the Hollywood meeting of the Committee, but no definite conclusions have yet been reached. No satisfactory standard for 16-mm sound-film sprockets has yet been attained.

The publication of the Academy standard 2000-ft. release print has been delayed pending further questions by the Academy.

FUTURE DEVELOPMENT IN THE FIELD OF THE PROJECTIONIST

The highly diversified activities required for the production of a motion picture find their effective culmination in the work of the theater projectionist. The unusually concentrated value embodied in the reels of film corresponding to a feature picture can be brought to the theater audience and made the basis for commercial returns only through the activities of the projectionist. Nevertheless the public is little aware of what goes on in the projection room.

The projectionist is in part compensated by the likely stability of his activities. His present position in the theater is important. Future developments in the motion picture field, such as three-dimensional sound, wider use of color, and the like, will make his work even more important. The possible inclusion of television projection in theater programs will require his mastery of the new field which is sufficiently similar to his present activities in its broad outline to enable its handling by the theater projectionist.

New Strong Mogul H-I Lamp

THE Strong Mogul high-intensity automatic reflector arc lamp, now being demonstrated by independent theatre supply dealers marks a distinct advance in projection arc lamp design and construction. It has been designed to project a volume of light even beyond the normal requirements of theatres employing the modern large screens of non-reflective surface and porous structure, screens that require a tremendous increase in light value to maintain a satisfactory level of illumination.

The higher efficiencies attained through the use of the Mogul result in this increased light intensity without a corresponding increase in operating costs. In fact, this improved projection is attained at a lower cost-per-light unit.

● Improved Arc Control

Designed to satisfy fully the most discriminating exhibitor and projectionist, the Mogul high-intensity arc projects a steady, brilliant light that is distributed uniformly over the complete screen area, projecting a picture which fairly sparkles and bringing out all the delicate details and possessing a realistic daylight effect. This is the same characteristic snow-white light used in the studios to produce Technicolor prints and is so essential to its proper projection.

Chief among the factors responsible for the outstanding performance of the Mogul are the ball-bearing motor, an arc control system which has *separate* adjustments for the feeding rate of *both* the positive and negative carbons, which are supported by full-floating holders and heat-resisting guides near their burning end to assure perfect coaxial alignment. The accurately formed optically corrected elliptical reflector 14 inches in diameter is held in a cast aluminum frame adjustable on its true optical axis.

● Modern Accessories

The Strong Mogul is pleasingly modern in design and of ample size to facilitate easy trimming and cleaning and to assure proper ventilation without disturbing the arc, which is stabilized by an electro-magnetic field. There is an ammeter with an illuminated dial, trimming and framing light, arc imager, inside dowser system interconnected with a mirror flame shield, a full-length removable ash tray, and three arc vision windows for vertical and lateral observation of carbon alignment.

Further particulars anent this new Mogul lamp are available through either independent theatre supply dealers or on application by I. P. readers direct to the manufacturer, Strong Electric Corp., Toledo, Ohio.

View of the new Strong Mogul H-I lamp showing general overall construction and lines. Note ample size for h-i work

THE PROJECTIONIST'S PART IN MAINTENANCE AND SERVICING

J. R. Prater

Congress Theatre, Palouse, Wash.

It is the duty of the projectionist to see that all projection equipment is kept in condition to give excellent service dependably and efficiently. It is impossible to accomplish these results by depending upon memory alone. The projectionist must establish and keep written records of all necessary maintenance data. He must follow a written schedule in making inspections and in doing maintenance work. He must establish a reliable system for checking and ordering supplies and spare parts at regular intervals.

The projectionist should do as much of actual service work as his knowledge, ability, tools, and available test equipment will permit. At least nine-tenths of trouble shooting should be done before any trouble exists. He should obtain detailed drawings of internal and installation wiring of all electrical equipment, besides identifying the points at which tests may be made. He should prepare a written outline of all tests that could be made if various troubles existed. Then he should actually make all possible tests in advance, wherever possible, without causing damage, by deliberately creating the trouble and then correcting it. He should immediately record the exact results of each test in the written outline. In this way, simple tests may serve as well as or better than elaborate ones.

The professional service engineer with special test equipment is a necessity to the finer and more difficult parts of modern servicing, but the projectionist who makes

the best of what resources he has can also do a very valuable part of the job.

DELIVERING LABORATORY RESULTS TO THEATRE PATRONS

J. R. Prater

***Congress Theatre*, Palouse, Wash.**

A discussion emphasing the importance of actually delivering the benefits of laboratory research and developments to the theater patrons who furnish the financial support for practically the entire motion picture industry. Accomplishments in photography, sound recording, projection, and sound reproduction are discussed briefly. Examples are given of various ways in which theatre screen results may suffer regardless of the excellence of films and equipment.

It is pointed out that whatever can be done to increase the projectionist's technical knowledge, ability, and pride in good workmanship will ultimately benefit the entire industry. To this end, it is suggested that if possible, information from the *Journal* of the S. M. P. E. be made easily available to projectionists.

AUTOMATIC SLIDE PROJECTORS FOR THE N. Y. WORLD'S FAIR

Fordyce E. Tuttle

Development Dept., Eastman Kodak Co.

Special slide-changing projectors were designed and built for the Kodachrome exhibit in the Eastman building at the New York World's Fair. The individual screen images are seventeen feet wide and twenty-two feet high. Eleven machines are synchronized so that panoramic scenes one hundred and eighty-seven feet long may be shown. Indexing of the slides is controlled by notches in a sound-film so that the entire program is automatic.

The slides in each machine are arranged in two rows, and each machine has two gates and two complete optical systems. All the slides in one row are rigidly bolted to a ring-gear forty-eight inches in diameter. For each new picture the ring-gear is spring-indexed into a new position. While one gear is being moved the other is stationary, and the picture being projected is in the stationary row. An optical compensator geared to the ring-gear corrects for any inaccuracies in indexing, and the image is optically "dowelled" on the screen. The accuracy of registration is such that one slide may be substituted for another without movement on the screen.

The light-source used is a 2500-watt, high color-temperature tungsten lamp. Water-cells and refrigerated air are used to cool the film in the gates. The shutter system is located between the lamp and the gate in order to minimize the heat at the gate. Shutters in the two beams are interlocked in such a way that while they are being moved the light to the screen is constant. The cross-dissolve may be rapid or slow depending on the type of transition desired.

Slide projectors similar in structure are also being used in the Perisphere Building. There the slides are projected in rapid enough succession to show motion.

A NEW NON-INTERMITTENT MOTION PICTURE PROJECTOR

F. Ehrenhaft and F. G. Back

The authors have designed a projector wherein the optical compensation is effected by means of a rotating glass prism. The problem was originally attacked from the viewpoint that by eliminating the errors inherent in the rotating glass prism, a projector could be designed that would be both simple and practicable. The dimensions of the rotating glass prism and its optical placement result from basic optical laws, and the arrangement depends upon the size of the image and on the materials.

Errors inherent in the rotating glass prism are (1) Non-linear displacement on the screen causing a lack of definition: (a) errors of the center rays, (b) errors of the corner rays, (c) errors caused by shrinking of the film; (2) Chromatical errors; (3) Spherical errors: (a) caused by the size of the prism, (b) caused by the deviation of light in glass; (4) Astigmatism caused by the movement of the prism; (5) Side images (projection of more than one frame on the screen); (6) Limited focus; (7) Defects by reflection.

Elimination of these errors was achieved by: (1) (a) Limitation of the effective rotation angle, (b) use of a curved gate, (c) establishing the tolerable limits of film shrinkage; (2) Calculating size and displacement of the colors at the extreme position of the prism; (3) (a) Use of special lenses or additional lenses corrected for glass instead of for air, (b) compensation by a curved gate; (4) Slip-shaped diaphragms; (5) Use of diverse diaphragms; (6) Use of special lenses or additional lenses; (7) Diaphragms for the condenser and screening off the edges of the rotating prism. Relation between amount of light on the screen, absence of flicker, and arrangement of condenser and lamp-filament.

These factors will be treated by means of illustrations and diagrams. A working model will be shown and test-films projected to illustrate what has been accomplished up to now.

MOTION PICTURE THEATRE AUDITORIUM LIGHTING

Ben Schlanger

The various functions of motion picture theater auditorium lighting are discussed. Particular analysis is made of the lighting which is used during the period in which the motion picture is projected. Past and present lighting practices in this respect are explained. The advantages and disadvantages of these practices, and a new type of lighting are discussed. It is proposed that the illumination levels of the interior surface of the auditorium be at greater levels than have been heretofore found to exist. A definite relationship between the screen brightness and that of the auditorium surfaces is indicated as desirable.

Recent tendencies toward higher screen brightnesses have made a very low intensity lighting in the auditorium much more undesirable, and therefore have made it more important to arrive at a new solution for motion theater auditorium lighting. The realism of the projected picture can be considerably heightened by proper surface illumination. Controlled reflected light coming from the screen and re-reflected from the interior surfaces is discussed as a medium for lighting.

RCA-FARNSWORTH PACT

Patent license agreements have been signed by RCA and the Farnsworth Television & Radio Corp. RCA has acquired

I. A. Happenings

Chicago Local 110 projectionists have been granted a 5% wage increase retroactive to Sept. 1, one-half of Union demand for full restoration of a summer cut last year.

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The I. A. was returned the victor in a N. L. R. B. election held among Hollywood studio workers. Contest resulted in 4,460 votes for I A. as against 1,967 votes in favor of United Studio Technicians Guild, a C.I.O.-backed outfit. Latter was supported in full-page newspaper ads by Screen Writers Guild. The outcomes forecast an early return by I. A. as a Basic Studio Agreement signatory.

Widespread disciplinary action by the I. A. against those who actively supported the Technicians Guild was forecast. The latter has protested this move to the N.L.R.B. as "interference with free choice". Not a few I. A. members face expulsion.

Immediately the results of the balloting became known, the I. A. pressed for and won a 10% wage increase, retroactive to Aug. 12, for the 12,000 studio workers it represents. Producers issued statement pointing to unyielding strike ultimatum by I. A. and added: "It cannot be said that the producers granted an increase or that they were persuaded that one was fair or economically possible; they merely surrendered. Industry revenues, hard hit by the European war, are decreasing to the point of disaster. It was purely submission to force".

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Bested on the West Coast, the C.I.O., through its United Theatrical & Motion Picture Service Employes Union in New York City, made another foray against the I. A. In two instances the new union has petitioned the State Labor Board for bargaining agent rights for ushers, cashiers and doormen in two large circuits, including RKO. The larger houses with ironclad I. A. contracts are beyond C.I.O. reach, of course, but small theatres may be susceptible.

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Settlement of the I.A.-Equity jurisdictional conflict centering around the American Federation of Actors, branch of Equity, averted a nationwide amusement field strike and resulted in a love feast between the combatants, who signatured a mutual assistance pact for the future. The A. F. A., along with director Ralph Whitehead, whose status precipitated the fireworks, passes out of the picture as far as the A. F. of L. is concerned, although Whitehead says he will continue the organization.

Outcome cemented Equity's hold on actor field, since I. A. promised no further moves in this direction. Last-minute settlement permitted reopening of musical "Leave it to Me" and made everybody happy—except Whitehead and Harry Richman, who was given two weeks in which to join new actors guild.

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Members of seven Seattle, Wash., theatrical unions in negotiating new contracts with theatre owners asked the inclusion of a "war clause" which would provide for the immediate arbitration of wages in the event that war increases living costs above normal levels. Also asked for all workers is clause anent two weeks' vacation with pay.

a non-exclusive license under Farnsworth patents for television receivers, transmitters and "other radio and sound recording and reproducing apparatus."

Farnsworth has, in turn, acquired a standard non-exclusive license for broadcast and television receivers and electrical phonographs under RCA patents and also other non-exclusive licenses for television and broadcast transmitters and "for its other field of business." Neither organization acquires any right to grant sub-licenses to third parties under the patents of the other corporation.

APPROVE GOLDE REWIND

GoldE Mfg. Co., originators of enclosed automatic rewinds, has received the approval of the Underwriters Laboratories on the re-examination of the Micro-Switch rewind of their manufacture. The Laboratories further recommends, in a recent bulletin, that the Enclosed Rewind be made a regular part of all projection room equipment. This recommendation is taken into favorable consideration by insurance underwriters and state code authorities in drafting their requirements.

Among the advantages of the GoldE rewind are micro-switch operation that assures positive accurate starting and stopping—any film breakage stops the rewind automatically; automatic stopping when door is opened, and all parts carefully and expertly finished and assembled.

Further details are available from either your local dealer or GoldE Mfg. Co., 1214 W. Madison St., Chicago.

Forest, Expanding, Moves

Effective Oct. 1, the new address of Forest, Inc., is 200 Mount Pleasant Ave., Newark, N. J. The change from Belleville, N. J. to these new and very much larger quarters reflects the rapidly expanding activities of this company, which recently added to its line of magnesium copper sulphide rectifier units a new Suprex projection lamp and a screen. All products will be marketed under the Forest name.

ALTEC RENEWS CIRCUITS

Lincoln Theatres, Inc., and King Coal Theatres, Inc., of Marion, Va., has renewed Altec service contracts on six theatres, and contracted for service on two additional houses.

M. & P. Theatres, of Boston, Mass., has renewed a contract to have Altec service the sound in 85 theatres throughout New England.

GTE DECLARES DIVIDEND

Directors of General Theaters Equipment Corp. have declared a cash dividend of 15 cents per share on the capital stock, payable Oct. 16 to stockholders of record Oct. 6.

RADIANT LAMP CO. EXPANDS

A plan to expand the corporate and financial structure of the Radiant Lamp Corp., Newark, N. J., has been approved by stockholders. The present sales executives will continue in direct charge. The Radiant plant manufactures a complete line of motion picture projection lamps.

MOTION PICTURE FLICKER

(*Continued from page* 20)

samples that were considered as just perceptibly degraded.

A discouraging thing about this flicker problem is that flicker has not existed day after day and week after week. Flicker has been definitely an intermittent problem, and during times of serious trouble has demanded the attention of many men, who, however, to my knowledge have not yet arrived at a true and final answer. The intermittent nature of this problem is undoubtedly due to the many factors involved. With all the work that the sound engineers have done on flutter it seems odd that a situation should exist that requires the same quality of motion but very little has been done about it, and the studios think the manufacturers should seriously undertake the problem because it is rather costly to have to make retakes.

Lamp Mechanism Vital Factor

Mr. Joy: This is an interesting paper. As manufacturers we have always worked along the lines of producing a carbon which will give a steady light. In fact, we have been working along the very same lines which Mr. Grignon suggests. As evidence of this I refer to Fig. 6, which is taken from our paper on "Recent Improvements in Carbons for Motion Picture Studio Arc Lighting."* This illustrates that improvement in the carbons has resulted in a very appreciable improvement in light steadiness. It should be realized also that a good lamp mechanism is necessary for the steady burning of the carbon.

In the Technical Bulletin "Recommendations on Process Projection Equipment" of the Academy Research Council, specifications and suggestions are given for burning a carbon in a projection system under conditions which, if followed, will go a long way toward eliminating any objectionable flicker. This illustrates again that besides having a good carbon it is necessary also to burn it properly to obtain the steady light desirable for either background projection or other lighting applications connected with the motion picture industry. It is evident that the work of Mr. Grignon and also of the Academy indicates that we are all striving toward the same common end, that is, to make a perfect motion picture.

Mr. Grignon stated in his paper that a flicker of around 6 to 8 cycles per second in frequency was most noticeable to the eye. Was this critical frequency established by observation or by some theoretical consideration?

Mr. Grignon: With a large series of tests we finally realized that those irregularities that were causing us the greatest amount of disturbance existed in the region of 6 and 8 cycles. This statement is not founded on any actual measurement, because to make such a measurement would require a series of studies and other technical data involving a great deal of work. However, it was quite apparent that this region presented the greatest disturbing frequencies.

Mr. Laube: What is the reaction in regard to the way we drive the 20th Century cameras—by drive from the motor to the shutter?

Mr. Grignon: It has been our experience that that would probably be better than the current type of drive. The best way to check this point is with a stroboscope which is accurately synchronized with the driving motor, preferably using a contractor on the motor to determine the flashing periods of the stroboscope. Early tests with a non-synchronized stroboscope were found to be misleading.

Mr. Laube: We feel that we have very good motion in the shutters on the 20th Century cameras. Stroboscopic tests are quite perfect. In background projection shots it is very desirable that each frame of projected picture remain on the screen for a longer time than the total length of time the camera requires o record it. When I refer to the length of time the projected picture remains on the screen, I am not including the element of time during which the shutter in the projector is uncovering or covering the aperture, but only the time when the picture has its full value on the screen and is not being dissolved in or out by the projector shutter. If this time period is long enough to overlap that of the camera's total recording time period, I feel that the condition thus described would be most ideal for flicker elimination in background projection shots.

Mr. Grignon: In background projection work that is important. If we assume a 7° variation in shutter operation, which we have observed, then, the projection shutter should be 14° wider than the camera shutter, or *vice versa.* In using a three-head or three-projector type for projection there is some improvement because the change in any one shutter affects only one-third of the total light and the result is only one-third as great also, there being three shutters, the change is more at random and the defect is not as serious.

Mr. Kellogg: Would you consider a disturbance that might occur every four seconds as disturbing?

Mr. Grignon: Offhand I would say that such a disturbance, unless of large magnitude or occurring simultaneously with other factors, would not be disturbing.

Studio Practice on Takes

Mr. Richardson: In the illumination of motion pictures, we do not have any rotary arc that carries the rotation of the positive carbon as high as 15 rpm. Practically all the modern lamps of the high-intensity rotary type operate at a positive rotation speed from 6 to 12 rpm.

There is another potential cause of flicker in the taking of pictures. In some studios it has been a practice to stop the rotation of the positive carbons during picture takes. This has come at the insistence of the sound recording departments in an attempt to reduce the mechanical noises from the high-intensity spot equipment. Some time ago a Committee of the Academy made a study of arc noise reduction. For this test work we had available to the Committee one of the quietest stages in the industry, a stage on which the ventilation system was made inoperative and the ground-noise cut to a very low level. The test was made with a battery of ten 150-ampere h.-i. arc spots centered around a microphone of the type used for recording dialog, in a semi-circle having a 25-ft. radius. Studies were made to ascertain the effects resulting from bringing the arcs into good trim and then

*To be published in a succeeding issue.

cutting the motors off. Our interest was primarily in sound. Careful records of this test were made, and they are available through the Academy to those who wish to study them.

While it is unquestionably desirable to eliminate all possible noise in these arcs, the test revealed that the mechanical noise is a small factor of the total noise, the principal disturbance coming from the phenomena in the electrical arc.

The point I want to bring to your attention particularly is the decay of light and the production of flicker in the photographing illumination. When motors are cut off on the studio arcs, not only is the rotation stopped, but also the feed of the positive and negative carbons. Under these conditions the arc rapidly becomes unsteady. The decrease in the illumination is practically linear, and five minutes of operation after the motors have been cut off produces a decrease of over 50 per cent in the total illumination. The unsteadiness of the illumination during this period of decrease steadily becomes worse and would surely, at the end of three minutes, be highly contributive to flicker.

However, it might be well to note that the flicker in illuminating sources under these conditions are random in each lamp. Those who are familiar with the studies made by the Sound Reduction Committee will agree, I believe, concerning the inadvisability of shutting off the motors on rotary arcs during photographic operations, both from the standpoint of its increasing light flicker and actually increasing, rather than decreasing, the noise produced by the arc's operating in a very erratic manner.

Mr. Grignon: From what Mr. Richardson says the arc rotational speed is about one revolution every four seconds and, as stated before, that in itself, as a result of our studies, would not show in the projected picture. However, in split-screen work if the lamp intensity changes should happen to be in opposition on the two halves of the picture then a push-pull effect obtains which is definitely disagreeable to the observer.

Mr. Richardson: Many studies and tests have been made relative to these light-projection problems. Commercial rotary arcs are in operation today that limit the light fluctuation from rotation of the positive carbon to a variation of ±3 per cent, and it is possible by refinement to reduce the effect still further.

Mr. Grignon: With respect to the rest of your point, Mr. Richardson, I do not have to defend the sound departments with regard to stopping the arc motors. I think that the motor noises that existed were of a periodic type that attracted attention. You are perfectly correct in saying that after a short period of time the general arc noise is increased. I also heard the tests you speak of. The noise, after a definite length of time is increased, but, however, that noise can be more readily tolerated since it is a random type of noise which shows up more as a constant sort of background behind the scene. Further, the tests of which you speak indicate clearly that even with lamps having acoustic treatment the motor noise is objectionable and for a period of about three to four minutes after disconnecting the feed motors a definite improvement in noise is obtained. Incidentally, three to four minutes time represents 270 to 360-foot takes, which are generally above the average take length.

Mr. Richardson: In photographing

Shirley Temple's first Technicolor picture at 20th Century-Fox, the sound engineers had a particularly difficult situation. In this picture there were a number of very intimate scenes which required the recording of the children's voices talking either together or to their nurse. The intimacy of the scenes and the diminutive voices had to be recorded against a background of almost constant level. When some of the first scenes were taken we were called upon to analyze a problem of under-exposure which Technicolor encountered in their photographic operations. This led to a special study of the decrease of light resulting from shutting off the motors of the rotary arcs, which had been the practice in taking these intimate sequences. The records of these studies are available to anyone who is particularly interested in studying this effect.

Some of these studies have revealed the effect of the "flash" type of flicker, which I think very definitely falls within this subject. These "flash" flickers are particularly prevalent in h.-i. arcs when the carbons are not operated at their normal consumption rates, and when the arc craters become unsymmetrical, which is always the case when the positive carbon which has been purposely designed to rotate, has its rotation slowed down, or is stopped.

Mr. Crabtree: How do you measure the flicker?

Mr. Grignon: We are not equipped to make accurate determinations of the various flicker effects. The pictures used for observation were made by photographing a neutral gray wall under various conditions of the mechanism, take-up belt, motor system, shutters, *etc.*, and by actually applying periodic disturbances to the motor shaft. These pictures were then submitted to the various observers for their comments. Later the test-films that were of interest were measured throughout their length by a method employing what was essentially a recording densitometer having a relatively slow time response so that the density of each frame was somewhat averaged.

Strictly comparative results were obtained by this method and the final answer obtained was, as noted in the paper, 3 per cent difference in transmission for perceptible flicker. More accurate methods of obtaining the data would certainly be of value and would definitely be required in order to separate the various types of flicker.

PROJECTION DAY AT FAIR

(*Continued from page* 11)

sults through the projection room port.

Millions of dollars and years of time of many people may be spent on a single feature film. Authors, writers, actors, directors, producers, cameramen, sound recordists, electricians, and a host of other studio personnel, as well as the laboratory and exchange workers may be required to deliver the feature film to the theatre. And then, the projectionist must "deliver the goods"—or else!

It is curious that most other workers in the industry occasionally receive public notice and praise, but this is one of the few occasions on which, so far as I know, the projectionist has received the public acclaim and recognition which is his due. I hope that it is the beginning of a new move to make the public understand that they meet the widespread skill of the projectionist

when they see good pictures, even though the projectionist modestly does his job back of the scenes.

A modern projection room from which black-and-white or color pictures and sound are projected is a place full of complicated equipment which requires skillful handling. The alert and capable projectionist of today has to know a lot more about pictures and sound than his predecessor of twenty-five years ago. Furthermore, the projectionist of tomorrow will have to know still more.

Demands of the Future

Looming on the horizon are increases in the use of color pictures which mean, in turn, a brighter and whiter screen with careful control of illumination intensity and color. New types of projection, of screens,

W. Reed, first U. S. projectionist is congratulated by Joe Basson, 306 prexy

and of theater design are all in the offing. Three dimensional sound—where the sound of the speaker appears to follow him around the screen—is one of our prospects. And, most startling of all, television projection is closer than "around the corner."

Speaking of television, it is interesting to know that in England television pictures as large as 15 x 20 feet are projected on the theater screen. While these pictures do not have either the full brightness or detail of present motion pictures of the same size, yet they have been good enough to fill large theaters repeatedly and to induce the theater chains to order the installation of not far from 100 of such television theater equipment of various types.

There are several fundamentally different sorts of television projectors for theaters, and no one is sure just what will constitute "standard" theater equipment in that field 5 or 10 years from now. However, it is reasonably certain that enterprising showmen will find timely and entertaining material suitable for theater presentation and that mixed film and television programs will gradually be accepted in the theater field.

Preparatory Work Necessary

I regard this as one of the finest and most encouraging prospects which the projectionist faces. The optical principles governing television projection may differ in detail from those used in film projection, but broadly they are quite similar. The sound reproduction in the television program is of course carried out by amplifiers and loud speakers as at present. The enterprising and up-to-date projectionist can master television projection as readily as he did film projection and can make himself just as invaluable in the theaters of the future as he is in the theaters of today.

The projectionists and their organizations might well study this new field and keep up-to-date on it so that, as it finds a place in the theater, they may be prepared to assume an important position in the television field as well. (Italics ours.—Ed.)

There are some lines of work where a man today might feel puzzled or worried as to his future. He might wonder whether there was going to be a demand for the commodity or services which he produces. Or he might doubt whether his field would hold its own against some new competitor. The projectionist of today is peculiarly fortunate. If he is energetic and determined in the future, he will be free from the dangers I have just mentioned. His field is an expanding field, with new opportunities and obligations.

You have my most hearty good wishes for your continued success in your chosen profession and my hope and belief that you will have the same key positions in the theaters of the future as you hold in the theaters of today.

PROJECTIONIST'S CONTRIBUTION TO THE S.M.P.E.

By E. A. Williford
President, S.M.P.E.

THE Society of Motion Picture Engineers is happy to cooperate in this tribute to the motion picture projectionist. Embracing as it does, every technical field of endeavor in this great industry, our Society is proud in having over 200 projectionists numbered in its membership. Many fine papers have been written and presented at our meetings by those men whose skill is the last word in bringing to the eyes and ears of the motion picture audiences of the world, the film productions upon which so much creative effort, time and money have been spent. In the work of our Society, many projectionists have served faithfully and with distinction on its various technical committees.

The Projection Practice Committee, in particular, for the past few years under the Chairmanship of Harry Rubin, has undertaken investigations and rendered reports on such industry technical problems as projection room design and construction; monitoring and sound control; projection room maintenance; film mutilation; equalization of projector outputs, and the preparation of a test film for projection room calibration.

It is a far cry from the hand-cranked projector of the early days of this industry to the highly complicated mechanisms for the projection of pictures and sound today. During the years intervening, the projectionist has kept pace with the demands of his craft. Television may come along to add further burdens to his technical skill. Continuing new developments in material, processes and machines, engineered by other groups of experts in the technology of motion pictures may keep the projectionist busy mastering new aspects of his art.

But as President of the S.M.P.E. I am happy to say that under the leadership of such men as have read papers before our Society (I would like to mention them by name, but the list would be too long and I would be sure to omit some worthy name), we feel your tasks will continue to be well done, and offer you the continued technical collaboration available through membership in our Society.

PROJECTIONIST'S CONTRIBUTION TO SOCIETY

By Nathan D. Golden
Chief, Motion Picture Division
U. S. Department of Commerce

THIS occasion is highly significant and gratifying to every member of the projectionists' craft. These exercises are indeed an honor justly due to a group of men who—though the nature of their calling requires them to stay in the background—nevertheless contribute constantly to the enhancement of the pleasure of enormous numbers of Americans, as they enjoy one of the livest and most satisfying of the arts.

My warm fellow-feeling for projectionists everywhere has its roots in my own youth-

ful experience. I'm still an active member of Local 160 of the I.A. in Cleveland. As one who first received his baptism in the motion picture industry back in the days when this present giant could hardly be said even to have "swaddling-clothes," it was my humble duty to be rewind boy in an exceedingly unpretentious theater—the entire equipment of that room consisting of a rewind and an Edison Universal projector. That was as long ago as 1907.

The motion picture world is almost as broad and varied and teeming with perpetual interest as the very earth itself. The projectionist today is proud to be part of an industry that represents an investment of more than 2 billion dollars here in the United States. He realizes that the product which he handles every day comes from one or more of the total of a hundred American firms producing motion pictures, whose yearly average of features is not less than 500. In 1938 the production costs in this industry reached the stupendous sum of $165,000,000. In order to produce a single motion picture, 276 different arts, crafts, and professions are required to "do their stuff," and these multifarious skills and talents are now exercised, in the motion-picture industry, by nearly 30,000 people, whose annual pay-roll is not far from 130 million dollars.

Those arresting figures refer, of course, to production only. In the exhibition field, of which the projectionist forms such a vital part, there are 241,000 people employed in the 16,250 theaters now open in this country. The average weekly attendance at these theaters is 85 million persons. Those lovers of the motion picture contribute yearly, at the box office, the colossal sum of approximately 1 billion dollars. Forming, as he does, a dynamic and irreplaceable element in a great human and material mechanism such as this, the projectionist has ground for pride.

True enough the projectionist is doomed to be inconspicuous, so far as the average members of the general public are concerned. He knows that he'll never get any fan mail; that nobody will be interested in photographing his nether extremities; that his face will never be lithographed in any multi-color process, and that he'll never be a guest star on Rudy Vallee's program. The projectionist knows full well that the public doesn't care whether he has any "oomph"!

As an offset to this, however, he has the satisfaction of doing a difficult job proficiently and faithfully. The fact that the average audience is oblivious of his presence is, in fact, the *supreme tribute* to the competence of his performance. It means that the show is going smoothly and efficiently, with no gaps, lacks, or hitches or mechanical flaws—which is precisely as it should be!

If something were to go wrong—if there should be a sudden stop or prolonged "sound outage" or any other obvious and disconcerting fault—the audience would abruptly become conscious of the man in the projection room. And that consciousness would be decidedly *critical.* When "audience-pleasure" is needlessly shattered, even for a few minutes, the prestige of the theater is impaired. Such damage to good-will might be costly. And, moreover, the projectionist—handling as he does some potentially dangerous material—may justly be said to have both lives and property within his care. All these values must be safeguarded. And they are magnificently safeguarded by the competent projectionist today.

It has been said that the projectionist is the "neck of the bottle" in the vast motion-picture industry. That, of course, is exactly true—but we might well vary the figure of speech. He is the activating element, the spark-plug, the generator, the man who brings the whole thing into vivid pulsating life. All of the inexpressibly complex and titanic process that has gone into the making of a picture would be futile if the projectionist and his apparatus didn't function. Writers of genius may create an enthralling and delightful story; scene-builders may erect the towers of ancient Babylon or the court of Kubla Kahn; specialists in studio magic may evoke terrific hurricanes or other weird catastrophes; tragediennes or glamour girls may be summoned from the ends of the earth; researchers may ransack libraries; rich properties may be acquired from the palaces of kings; intriguing make-up may be applied; thousands of brilliant costumes may be worn; directors may achieve feats that stagger the imagination; the editing may be adroit; the publicity may be inspired and spectacular; all this, I say, may happen in the creation of one of our superb American films today, but if the projectionist and his apparatus weren't on the job, if *he* didn't turn in his normal proficient performance, the whole stupendous effort would be just so much waste motion.

So one can hardly overstress the importance of a good projectionist. He has a responsible post. His work indeed, is indispensable. He has every reason to be proud of his place in the amusement world. He has every incentive not only to maintain that place but to go forward through ever-better training, ever-keener enthusiasm, and firmly grounded aspirations.

THE PROGRESSIVE PROJECTIONIST

By James J. Finn

Editor, International Projectionist

PROGRESSIVISM is a term not susceptible of easy definition, for a number of reasons chief among which is that of individual viewpoint; yet I anticipate no serious disagreement with the statement that any motion picture projectionist worthy of the name is a progressionist. Both terms, in fact, are of necessity synonymous. As is the case with all generalities, the foregoing premise is subject to interpretation and clarification; but happily there exists no dearth of data by means of which this stand may be buttressed.

Upon the pages of the trade, technical and lay press has been spread in fulsome measure a number of eye-arresting and ear-attuned phrases of a general nature designed to at once enhance the prestige of the projectionist and provide a bulwark against what are not infrequently unwarranted attacks against his status as a craftsman—phrases which I, try as I might, could never regard as other than wholly negative and defensive in nature.

There is nothing static about the course of the motion picture industry during the past ten years, and in no branch of industry effort is this fact brought home more forcibly than in the projection field. Could the projectionist of ten years ago assume instantly and unaided the duties incident to the present comparatively high standards of visual and sound motion picture projection? The answer must be an emphatic "No"! and this reply in itself is proof conclusive that the projectionist is and must be a

progressionist, that he may not, under penalty of extreme personal peril, remain static in so dynamic an industry as that of motion pictures.

But consideration of equipment and technique of ten years ago undoubtedly favors the affirmative side of this discussion. So let us consider briefly only a few technical developments within the past five years an intimate knowledge of all phases of which was essential to the satisfactory discharge of projection duties.

Many Technical Advances

The Suprex projection arc, as a case in point, easily ranks first among recent technical advances. Here was an arc that delivered (1) a whiter screen light (2) 150 to 200 per cent more screen illumination (3) a high permissible level of general illumination (4) greater clarity and depth in the projection of black-and-white productions, and (5) more accurate rendition of color values in such productions—all this at no appreciable increase in cost on the vitally important scores of candle-power and of light per unit of screen area.

It is no exaggeration to credit the projectionist craft with the ready acceptance accorded this fine equipment; in fact, I suspect that projectionists provided the driving force so necessary to overcome the natural human opposition to change—and in this case, drastic change—that was widely evident among the non-technical managerial forces within the industry. Also, it so happens that this particular equipment was in the nature of a prima donna among projection arcs, so critical in operation as to require the most exacting degree of craftsmanship from projectionists. The success of this light source testifies eloquently to the splendid successes scored by projectionists in surmounting these hurdles. Thus it was, and is, that projectionists contributed materially to the welfare of the industry in two important particulars—those of improved technique and greater economy of operation.

The record is replete with other similar instances, only a few of which need be cited here. Ten years ago a theatre sound picture installation cost $20,000; today such equipment can be purchased for $2000 and it delivers infinitely better results. The frequency range of sound pictures reproduced in American theaters today is almost double

that level which was attainable some years ago. New and radically different sources of power supply have been made available, such as bulb- and disc-type rectifiers, and motor generators.

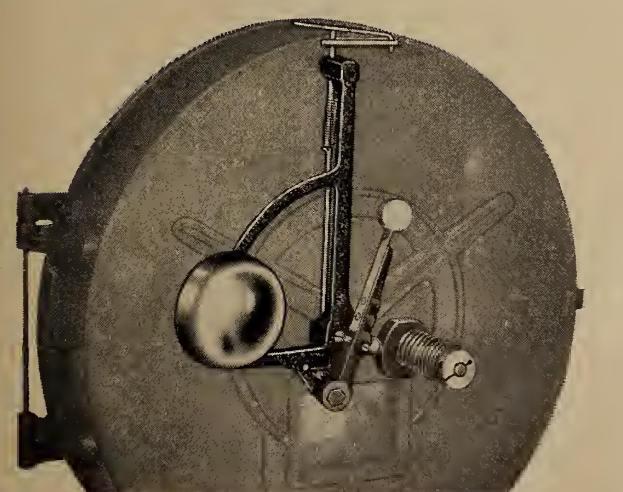
Only a few years ago the various units comprising a complete projection room installation constituted an engineering horror in the form of a polygot collection of visual and sound reproducing units which were hooked together somehow or other and which produced results which accurately reflected their geneses. Today there are available complete room installations the components of which match and mesh with each other with unerring precision. The very heart of a motion picture reproducing system—the projector head—has been continually improved and refined to a point where it ranks with the outstanding accomplishments of American engineering. The automobile industry, acknowledged bellwether of American business, boasts proudly of its engineering talent which deals with tolerances of the order of one ten-thousandth of an inch; yet such tolerances have been commonplace for years in motion picture engineering.

The jumping-off place, so to speak, for all these products of imagination, brain power and sinew, as far as the motion picture industry is concerned, is the projection room. Here it is that accounts are cast up, where the inexorable demands of good performance must be satisfied—else all the effort and expenditure of money that has preceded this first call for performance goes for naught. And here it is where the projectionist is supreme, a domain wherein the craftsmanship or lack of it on the part of the projectionist can send crashing to earth the mighty structure that is the motion picture industry of today.

This record of accomplishment could not possibly be compiled by any automaton, by one who merely approached his daily tasks with the dreary outlook of one committed by economic necessity to just another day's work. This is a record compiled by a group of craftsmen who surely have earned the designation of progressionists. We might well inquire briefly into the manner of how they got that way.

The Progressive Projectionist

The progressive projectionist, to my way of thinking, is one who is alive and alert not only to those essentials of his craft, such as technical information, but who also sustains a broad general interest in industry problems and happenings. He should be cognizant of the whole chain of events which precede the delivery of the finished print to the projection room—from the manufacture of film stock down through the successive steps of photography, set lighting, sound recording, laboratory processes and the handling of prints by exchanges. He should keep abreast of those developments in the field of electricity, mechanics and optics which affect, however remotely, his daily work. He should exhibit a lively interest in every announcement by manufacturers and laboratories—for surely there is no news more vital to the advancement of projection than that pertaining to improved equipment and advanced technique. He should cooperate with equipment manufacturers in every respect and instead of fuming inwardly at some defect in a particular equipment, whether real or fancied, be glad to pass along his findings to the proper quarter. He should cooperate wholeheartedly with such servicemen as visit his projection room, not overlooking the opportunity to glean profitable informa-



tion therefrom. He should be always ready to meet every operating emergency, and this requires that he obtain and keep in good order a full set of working tools.

The progressive projectionist should render absolute fealty to his labor organization, which safeguards his income and upholds his working conditions, even though he insist upon preserving his individual rights. The man who does not respect his obligations to the organization that protects him upon the job need not expect recognition of his rights by the employer.

The progressive projectionist should exhibit a lively interest in *all* occurrences within the industry of which he is a part, for inevitably these happenings will affect his security. He will maintain a keen interest in the welfare of his employer, being particularly careful to establish cordial relations with the rest of the staff and particularly with his brother projectionists, especially in the matter of the division of duties. The absence of harmony among the projection staff invites disaster for the entire theater operation.

Every foot of film should be carefully inspected before being projected both as a service to the employer and as protection for the projectionist. He should support those

Jim Finn and P. A. McGuire strike an attitude after the program ended

journals which both inform and support him—not necessarily mine. Last, but for that very reason of the utmost importance, the projectionist should keep eternally after the non-technical-minded manager or owner to replace worn or defective equipment, to the end that this great industry shall see the end of such absurdities as taped moving parts and so that the audience, the employees and the theatre not be endangered as a result of mechanical breakdown.

This, then, is the credo of the progressive projectionist—a credo which is exemplified by the imposing record of service compiled by thousands of projectionist craftsmen throughout the world for the many years past.

The immediate future will test this craftsmanship to the utmost. New lamps, metal mirrors, a new series of lenses, new sources of power supply, and the possibility of television in the theater are just a few of the many problems confronting the craft. I have not the slightest doubt that these problems will succumb to the same high degree of craftsmanship that has characterized projectionists' efforts to date. For surely, "progress is the activity of today and the assurance of tomorrow."

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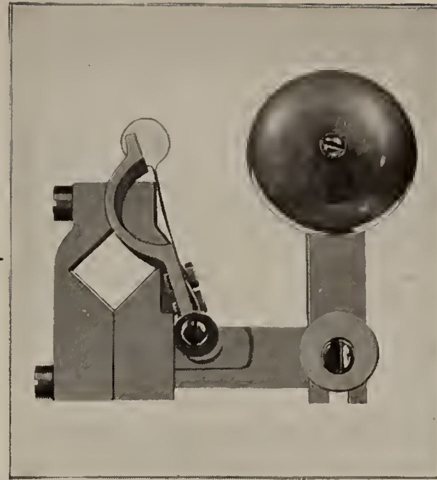

STRONG REEL-END SIGNAL

(Patent Pending)

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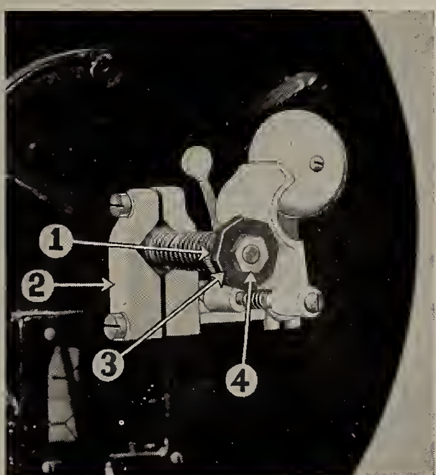

1. **Regular spring lock nut.**
2. **Signal clamped to magazine housing.**
3. **Fibre disc.**
4. **Lock nut for fibre disc.**

The story on this new and unique device is as simple as the unit itself. Here it is:

1. Does not touch the film or reel.
2. It is *strictly mechanical* and requires no batteries, no transformers, no governors, and no pre-setting by the projectionist.
3. Is not dependent upon any change in the normal smooth operation of the projector.
4. It is installed within 5 minutes, requiring no drilling.
5. Once installed, forget it—as was conclusively demonstrated by 1200 tests under practical conditions in various projection rooms.

INSTALLATION: A multiple-sided fibre disc (3 in photo to the left) is mounted on the end of the upper magazine shaft and is held in place by the locking nut (4). The signal is clamped onto the outside of the magazine, the vibrating arm resting against the fibre disc. This arm is held against the disc by a spring. Mounted on this arm is a vibrating reed having a lead weight on its end.

OPERATION: As the film in the upper magazine decreases, the reel naturally revolves faster, as does the shaft. When 115 feet of film remain on the reel, the fibre disc on the shaft end is revolving at just the correct speed to impart the correct frequency to the vibrating reed so as to cause contact with the bell. This frequency of vibration continues for about 15 seconds, during which time the lead hammer is contacting the bell.

After 15 seconds the fibre disc is revolving so fast that it has exceeded the vibration frequency at which the bell will be contacted—thus the bell stops ringing. Thus, 75 seconds before the end of the reel the bell begins to ring, continuing distinctly for 15 seconds, after which period of time it ceases. The duration of the bell-signal can be increased or decreased about 15 seconds by simply moving the arm to either the left or the right.

Install it and Forget it—
It is Always Set!

Projectionists are enthusiastic about this new and novel Strong Reel-End Signal on the score of its simplicity, absolute reliability of operation, ease and speed of installation—no less than because it does not touch either the film or the reel. The first lot of Strong Reel-End Signals was quickly disposed of to several large theatre circuits, including Paramount, which companies approved the unit immediately upon demonstration.

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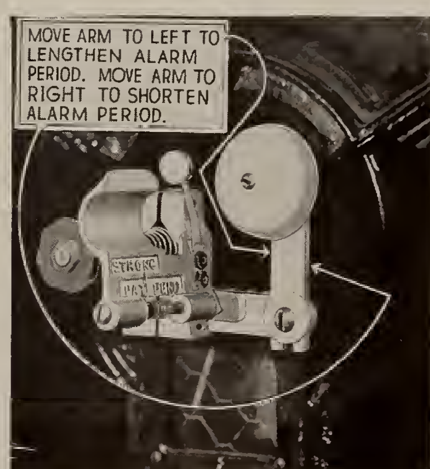

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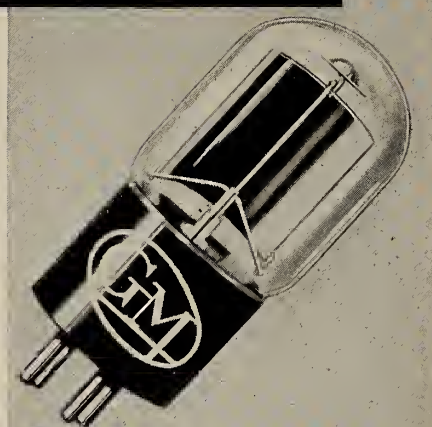

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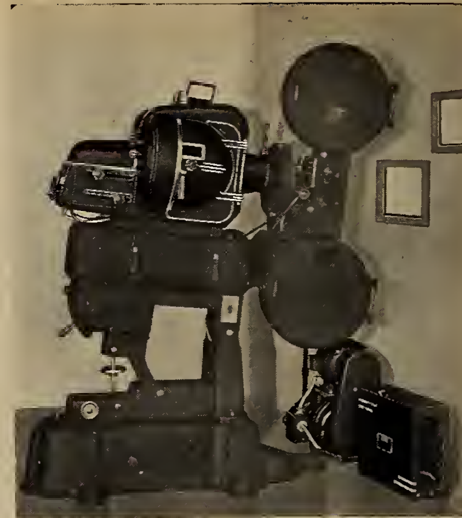

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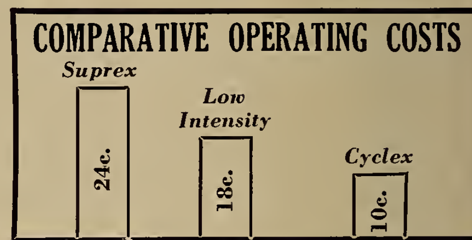

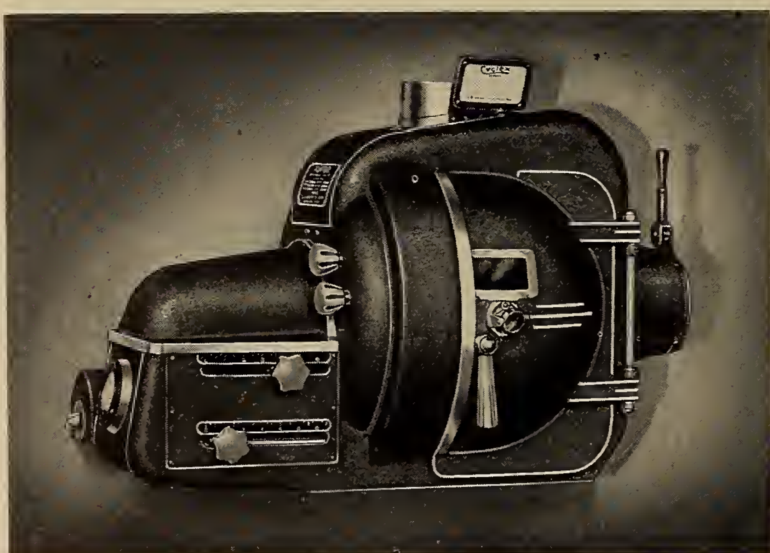

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With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

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Monthly Chat

IF WE were an exchangeman we wouldn't take from a cop that which Harry Rubin handed out at the Projection Session incident to the recent SMPE Convention. Rubin, director of projection for Paramount, charged that, while there have been very definite advances scored by the projection craft during the past ten years, or since the introduction of sound pictures, he could not give the exchanges a similar boost. In fact, said Rubin, all the evils of inefficient exchange operation still were visible in the prints being turned out these days—plus a few additional evils as a result of the increasingly common practice of shipping prints from one theatre to another without interim inspection.

Heretofore the chief complainant against current exchange practice has been Thad Barrows, who regularly cited the delinquencies of exchange procedure in the Boston area. The Rubin indictment sustains the Barrows viewpoint — and adds a few more counts.

Print shortages are the product of allegedly economy-minded executives who skimp on prints with one hand and with the other hand out and accept "bonuses" to themselves and the boys. It's the old, old story of the tendency of the picture business to water the leaves and neglect the roots —once the master print is in the can their interest in the physical aspects of the job ceases abruptly.

If the general run of prints be as deficient as Rubin asserts they are, then the course of the average projectionist who handles these releases every day is crystal clear. Inspection of every foot of film that comes into a projection room must be intensified—not only because the projectionist should be interested in averting any incident which might result in his having a few souvenirs in the form of red welts across his body, but also to protect him on the job when, as and if the exchange presents his boss with a tab for either damaged film or for footage lost in a fire. And these exchange fellers certainly can bill 'em.

Should inspection of a given print reveal any serious deficiencies—and even if it show only an excess of dirt and oil—the projectionist should lose no time in making a *formal written report* thereon to the house manager. The latter may do as he pleases about the report, but Mr. Projectionist then is protected against any possible contingency.

We regard this matter of poor prints so seriously as to suggest that the various local unions insist, as a matter of union law, that a written report on every print received for projection be handed to the manager, preferably before showtime. This would put the issue squarely up to the theatre management and the exchanges—which is precisely where it belongs.

INTERNATIONAL PROJECTIONIST

VOLUME XIV NUMBER 9

OCTOBER 1939

Design and Operating Data on the 'Cyclex' Projection System

By *C. S. ASHCRAFT*

C. S. ASHCRAFT MFG. CORP.

Here is the most authoritative information available to date on the new 'Cyclex' system of projection—written by its sponsor. This equipment has induced great interest in the theatre field, which prompts a restatement of the I. P. policy to invite comment from anybody having anything interesting to say about the projection process, including of course this new system.

THIS article is intended to provide a technical explanation of the Cyclex method of light projection for motion pictures. This new method consists of three distinct developments closely inter-related and combined in such manner as to provide those theatres of small and medium size with a light and power source which will produce a white uniform light at minimum operating expense.

Cyclex is intended for those theatres which find low-intensity wholly inadequate, and Suprex unnecessary and the cost prohibitive. In other words, Cyclex provides the medium and small theatre with the same quality and quantity of light as has heretofore been enjoyed only by the larger theatres. The outstanding developments of Cyclex are:

1. Cyclo-Harmonic Light Projection

A method of motion picture projection employing alternating current which produces screen results heretofore obtainable only with direct current. Cyclex light is white and uniform.

2. The Cyclex Power Unit

Produces a current of properly coordinated frequency for use in the Cyclex Arc. The driving motor of this unit is less than 1/6th the size of those ordinarily used on motor generators for low-intensity. By a distinctly new method it is possible to operate both arcs simultaneously, *yet at no time are both operated from the rotary unit.*

3. The Cyclex Arc

It is quite different from all other arcs previously used for motion picture projection. The arc voltage has been reduced by one-half without an increase in the current. This fact, and a new method of arc operation, results in an arc using less than one-half the power ordinarily consumed, and while the carbon consumption is proportionately low, the light output is greatly increased.

The Cyclex arc operates normally at a power consumption rate of only 950 arc watts. While the power range is comparatively wide, excellent results will be obtained with this power input. The arc operates at an abnormally low voltage and short arc gap, the latter being between .100 and .125 inch, as shown in Fig. 1.

The writer has found that by highly compressing the luminescent gas into such a short arc gap, the intrinsic brilliancy of the arc is materially increased. In previous forms of the a.c. arc the points of highest luminosity, which were closely adjacent to the ends of the electrodes, were not used to the best advantage. The presence of these points was well known, but the fact that they were widely separated pre-

cluded any possibility of utilizing them.

By compressing these flames into a distance of about 1/8″ a very dense flattened ball of flame is created having an exceptionally high intrinsic brilliancy. The Cyclex reflector is focused upon the densest portion of this compressed ball, resulting in an extremely high screen brilliancy. Whereas previous a.c. arcs produced a light of an extremely blue color, the Cyclex light embodies a full and well-balanced spectrum complimentary to both black and white, and color film.

In addition to the great reduction in power consumption, an outstanding fact is that the Cyclex arc normally consumes each carbon at a rate of only 3″ per hour, which is less than one-half that of any other arc utilizing impregnated core carbons. The maximum burning rate is only 4″ per hour, and the minimum is 2½″ per hour. Unlike Suprex or high intensity the rate of carbon consumption is only in direct proportion to the power used, there being no point where the carbon rate increases rapidly with a small increase in arc current. These conditions contribute to efficiency and economy.

In order to produce the proper current for the operation of the Cyclex arc in the most practical manner and with the minimum of complication and resultant cost to the theatre, it was necessary to discard all previous methods of power conversion used for motion picture projection. The old conventional methods, making it necessary to use a power unit of twice the size required for the operation of the single arc which projects the picture, for the mere purpose of heating the second arc preliminary to the projection of the picture by that arc, did not lend itself

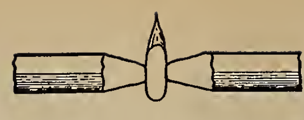

FIGURE 1. ***The Cyclex arc***

to the production of the Cyclex system. Fortunately, the characteristics of the latter adapt it to a much simpler and far less costly method. It was found that the Cyclex arc could be rapidly shifted from current supplies of entirely different frequency and voltage, instantaneously adapting itself to the new conditions without time lapse.

The most simple and inexpensive method of supplying a.c. of commercial frequency to an arc is by means of a simple static transformer. Obviously the light projected by an arc operated on such a supply is useless for the projection of the picture, but for heating purposes it is ideal. Such a device, therefore, has been incorporated in the Cyclex power unit for this purpose. For producing a current suitable for projection a highly efficient type of frequency converter is employed consisting of a rotary transformer driven by a small motor.

It is possible by means of the combination of the static and rotary transformers, with a suitable switching device, to operate both arcs simultaneously, the one on commercial frequency, unsuitable for projection, and the other on co-ordinated frequency. *At no time is it possible to load both arcs on either unit at the same time.* Ideal changeovers will result, there being no possibility of a drop in illumination, as is often the case where d.c. is employed. Automatic switching is accomplished by a double-throw relay operated by the light changeover devices necessary in all projection rooms. It is not left to the projectionist to switch the current, *this being automatic and simultaneous with the picture changeover.*

In Fig. 3 is shown the entire arrangement of converter-transformers-switching arrangement and arcs interconnected for projection. Polyphase current is shown at the entrance switch, either two- or three-phase being satisfactory (single phase cannot be used), as the principle of frequency conversion used in Cyclex operation is dependent on the rotating magnetic field in the rotary transformer.

The polyphase current is shown wired

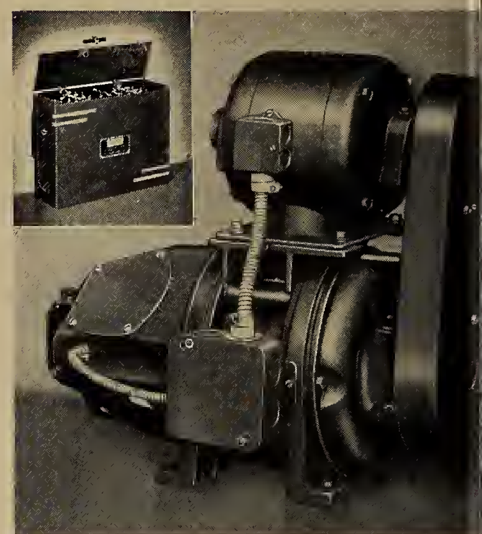

FIGURE 2. ***Power and control unit***

to the junction box located on the converter where it is distributed to the driving motor, the rotary transformer and the control unit. The converter, producing co-ordinated frequency, is shown wired from the rotor of the converter to the magnetic switch which alternately distributes current of both frequencies to the respective primaries of the two static transformers.

The magnetic switch is operated, in this instance, by conncting the operating coils to the foot- or hand-switches of a standard changeover device. However, a single-coil switch is entirely satisfactory where such magnetic

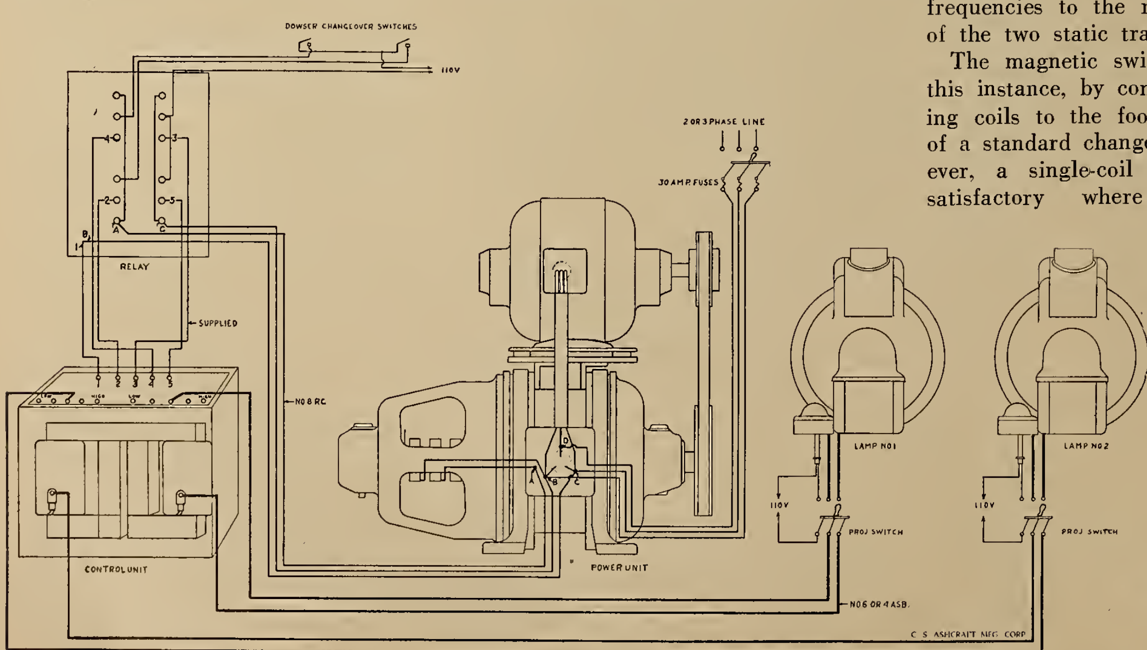

FIGURE 3

Showing hookup for Cyclex system

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changeovers are not employed. The single-coil type can be operated from a hand changeover bar or by the hand dowser located on the lamphouse cone. Arrangements have been made to adapt the magnetic changeover to any device which may be employed by the individual theatre.

While the voltages of the commercial frequencies (220–380–440–550, *etc.*) are not suitable for direct connection to the arc, nor is that of the converter, the static transformer, besides being a distributing means, also changes these voltages to the proper value for use in the arcs.

Figure 2 shows the converter proper, consisting of the rotary transformer (located below) driven by the small motor mounted together so as to form one compact unit. Power transmission is by a heavy vee-belt designed to transmit three times the power required. As shown in Fig. 3, the commercial frequency current enters the primary or stator of the rotary converter, causing a rotary magnetic field within which the secondary (rotor) of the transformer is revolved in a direction opposite to the rotation of the field. From the rotating secondary of the converter the arc current is transmitted through brushes and collector rings and sheathed wires to the control unit, where it is transformed to the proper voltage for direct use in the arc and switched to the proper arc at the will of the projectionist.

The converter is constructed of only such units as will have very long life. There are no commutators to cause trouble, and the load on the bearings is so slight that possibility of trouble from this cause is negligible. The power system is so designed electrically that heavy overloads are automatically made impossible. Beyond a predetermined maximum current output the current decreases through reactance when attempts to further increase the current is made. This safety feature positively prevents overload of the converter beyond safe limits.

● The Control Unit

Figure 2 shows the complete control cabinet which is connected, through flexible metal conduit protected leads, to the junction box of the converter as shown in Fig. 3. The function of the unit is (1) to receive currents of single-phase, both commercial and co-ordinated frequencies, from the power line and converter, respectively, and transform them to the proper voltage values for use in the arcs; (2) provide adjustments for varying the voltages of both commercial and co-ordinated frequency currents supplied to the arc, and (3) provide switching means for transmitting the current of the proper frequency to the arc desired at the will of the projectionist.

Attached to the control cabinet and connected to the transformer is the magnetic switch for current distribution to the two arcs. This switch has two separate coils which are connected to the respective changeover switches located at the projection machine.

The control unit, which is very compact and occupies very little space (7 x 18 x 19 inches), can be placed in any convenient location. For instance, the converter which is also very small (18 x 21 x 12 inches), and is quiet in operation, can be located in the projection room with the control unit in front or to the rear of it, or the control cabinet can be placed on a shelf above the converter proper. If it be desired to locate the converter outside the projection room and the control cabinet in the room, only three wires are necessary to interconnect the two units. The Cyclex system is exceedingly flexible, but due to the very low arc voltage it is preferable that short wires of ample size connect the control cabinet to the arcs and that all connections be very secure.

During the writer's exhaustive study of the cause of a.c. flicker on commercial frequencies, numerous charts and graphs were made showing the results at many frequencies, commercial and otherwise. By means of these graphs, which will later be explained in detail, it is possible to analyze the resulting pulsation at any frequency. More important, however, is the discovery that by properly co-ordinating the component light impulse frequencies and, in turn, combining these with other factors of definite values, we can produce what we will call "Cyclo-Harmonic Light Projection." This term is applied to a condition existing when light impulses of certain frequencies are passed through a shutter having definite characteristics which intercepts the light beam at a rate relative to the light-impulse frequency. When such a condition exists there is a complete absence of secondary pulsations in the projected light. Light from such an arc is steady and particularly adaptable to the projection of motion pictures.

The subject of co-ordinated light impulse frequencies can be explained in other ways, of course, but the simple graphic method seems the most appropriate.

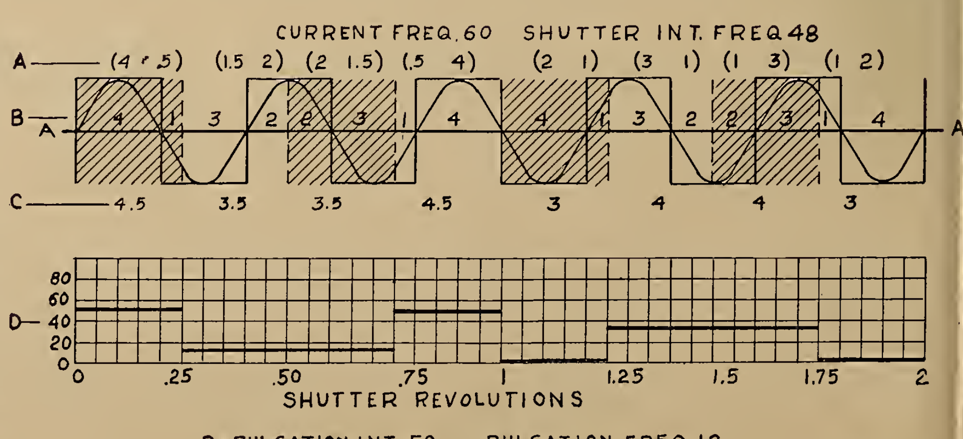
In motion picture projection there is one factor which is almost universally standard, that is, a shutter having two blades of 90 degrees each, revolving at a speed of 1440 r.p.m., or 24 revolutions per second. Any light intercepted by the shutter will, of course, have a screen frequency of 48 cycles per second, which is beyond the frequency of ordinary perceptibility. Only one-half of the light striking the shutter would be allowed to pass through, the other half being intercepted by the two blades.

All other factors remaining the same, if 50 cycle current be supplied to the arc, not only will there be the primary light frequency of 48 cycles, but upon this frequency there will be superimposed a secondary pulsation, the frequency of which will be the differential between the arc supply frequency and the shutter interception frequency, or, in this specific case, a frequency of 2 pulsations per second. Likewise, if 60-cycle current be supplied to the arc, the differential of 12 will result in a 12-cycle pulsation.

While the 2-cycle pulsation of 50-cycle arc supply current appears on the screen as a relatively slow pulsation, the 12-cycle pulsation of 60-cycle current causes a violent flicker. Both frequencies, 50 and 60 cycles, are wholly unsuited for motion picture projection where good projection is expected.

Since 50- and 60-cycle currents are both commercial frequencies used in the U. S. and other countries, an analysis

FIGURE 4



of both will be made, showing what occurs during each fractional part of a second.

Figure 4 is a diagram representing the opening and closing periods of a two-bladed shutter having 90-degree blades diametrically opposed, that is, the width of the blades is equal to that of the light openings, during two complete revolutions of the shutter, which is represented as rotating 24 times per second. Each shaded section represents that portion of the revolution during which the light is intercepted by a shutter blade; each unshaded section representing the open sections during which the light is allowed to pass to the screen.

The shutter rotates 24 times per second, therefore two open and two closed sections represent 1/24th of a second, and each open or closed section 1/96th second, in elapsed time. In Fig. 4 it will be noted that the sine wave of the 60-cycle current has been superimposed on the shutter chart, the relation of each half-cycle or alternation of the arc supply current to each shutter opening and closing being clearly shown. In this case each shutter opening and each shutter closing occurs in 1/96th of a second, whereas each half-cycle of current occurs in 1/120th of a second. Therefore the time values will appear in the ratio 96 to 120, or 4 to 5.

The relative time value of each is shown during each open and closed period of the shutter, each section being divided, hypothetically, into five equal parts. During the first closing, the 60-cycle half-cycle extends over four of these parts, the figure 4 indicating the time value of the alternation relative to the time consumed by the shutter during one complete interruption.

All alternations above the zero line A-A′ represent those alternations acting upon the carbon facing the reflector (which will hereinafter be referred to as the "positive" alternation acting upon the positive carbon). The full force of the positive alternation will therefore be active in the projection of light.

Those alternations below the zero line (which will be designated the "negative" alternation acting upon the negative carbon) will act on that carbon facing away from the reflector. A considerable amount of light produced by this alternation will be inactive for projection, due to the position of the electrode relative to the reflector, and we can only estimate its value relative to that of the carbon facing the reflector. It has been assumed that these values indicated by the letter "B" are in the ratio of 1 to .5, therefore all full positive alternations will have a relative value of 4, while the negative alternations a value of 2. Extensive experiment indicates that these values are correct.

Figure 4 shows that during the first shutter opening ¾ths of a negative alternation and ½ of a positive alternation are projected, through the shutter, to the screen. During the second shutter opening ¼th of a negative alternation and a complete positive alternation are projected. During the third shutter opening ¾ths of a positive and one-half of a negative alternation are projected. During the fourth shutter opening ¼th positive and one complete negative alternation are projected.

Above the graph, in parenthesis, are given the comparative numerical values of each portion of the positive and negative alternations occurring during each shutter opening and closing for the two complete revolutions. These are titled "Alternation Light Values" indicated by the letter "A". Below the graph are shown the sum of the light values of both alternations occurring during each 1/96th second the shutter is open or closed and indicated by the letter "C".

The shutter openings are, in the case of 60-cycle current, shown as passing light values in the successive ratios of 3.5, 4.5, 4, and 3; after which this cycle is repeated. Since a complete cycle of varying light values occurs during two revolutions of the shutter, it follows that during 24 revolutions, or in one second, 12 cycles will occur, producing a 12-cycle pulsation upon the screen.

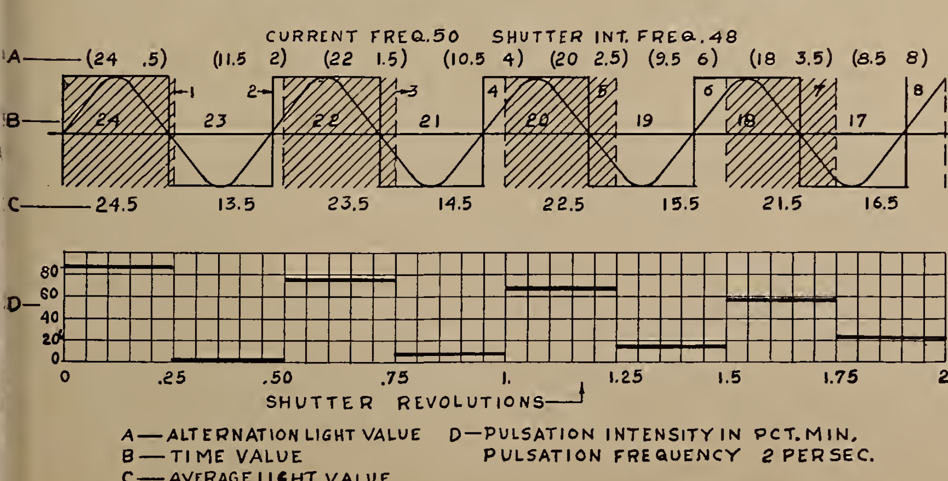
Not only is the frequency of the pulsation of importance but also the relative intensity of each pulsation must be known and is of importance if the subject of frequency co-ordination is to be thoroughly understood. In Fig. 4 (lower chart) the comparative values of each light impulse projected during each consecutive shutter opening is shown graphically. The resultant levels are shown to be of unsymmetrical form, a rapid rise occuring from the value of 3.5 to 4.5 and a more gradual decrease to a value of 3 shown during the period of the third and fourth shutter openings.

In this and following charts, the maximum increase over the minimum value of intensity will be computed and the result shown in percent of increase and titled "Pulsation Intensity." In the case under consideration the minimum intensity is 3 and the maximum 4.5, or a pulsation intensity of 50%. Fig. 4 also shows the light value level during each 1/96th second of the two complete shutter revolutions. There seems to be no definite order to these, a distinguishing feature of 60-cycle current. All other frequencies shown in subsequent graphs have a definite order of values during the two shutter revolutions.

Following the same line of reasoning as in the case of 60 cycles, it will be found that the ratio of shutter opening time to the elapsed time of the 50-cycle alternation is in the ratio of 96 to 100, or 24 to 25, therefore each 1/96th second of shutter opening may be hypothetically divided into 25 parts, over 24 of which the 50-cycle alternation will extend as shown in the first section of Fig. 5. The four successive shutter openings show a gradually increasing amount of positive alternation while a gradually decreasing amount of negative alternation is being projected toward the screen. The successive average values of these are in the ratio of 13.5, 14.5, 15.5, and 16.5, indicating that a gradually increasing light intensity is being built up to a certain point, after which it will gradually decrease to a minimum, this cycle thereafter being repeated twice during each second of operation.

In Fig. 5, should the phase relation between the shutter and current shift 90 degrees to the right, the light pulsation value would be reflected as shown in the lower chart. A maximum light

FIGURE 5



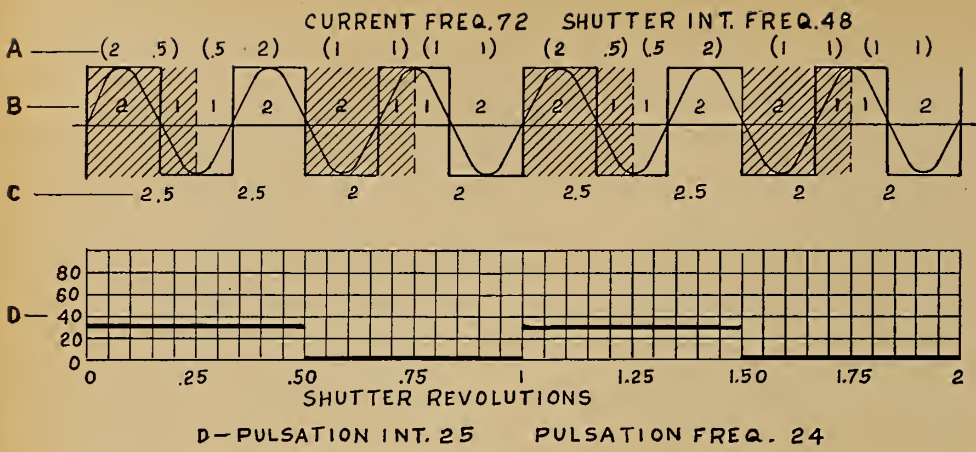


FIGURE 6

value of 24.5 is shown in the first 1/96th second, and a minimum value of 13.5 in the second 1/96th second; therefore a shift of 90 degrees would result in a shift from maximum to a minimum light value, a difference of 81% exists in the relative light values.

Thus, in the case of 50 cycles, while the increase and decrease of intensity is gradual, the rapidity of the pulsation cycles results in a definite beat upon the screen.

Nothing can be done with either of the two commercial frequencies mentioned. There are no characteristics which lend themselves to synchronism in any way; in fact, of all the frequencies above 48 cycles they present the most difficulty as far as motion picture projection is concerned.

Beginning with 60 cycles, arc current frequencies in steps of 12 have been selected for analysis in order to show the frequency and intensity of the resultant pulsations on the screen.

Figure 6 shows a current frequency of 72 cycles superimposed on the same shutter frequency chart as was used in illustrating 50 and 60 cycles. The ratio of shutter opening time to half-cycle time is in the ratio of 96 to 144, or 2 to 3. The successive light values for each shutter opening in the order of 2.5, 2, 2.5, and 2, showing that the increase in intensity is from minimum to maximum once during each shutter revolution, thereby producing a pulsation of 24 cycles per second.

Even though the phase be shifted 90 degrees, the same values will prevail. Fig. 6 shows the pulsation intensity to be 25% and the pulsation levels to be equal during alternate 48ths of a second. Successive 48ths of a second, however, indicate a difference of 25%. The graph shows that while the rapidity of the pulsations have doubled over those occurring at 60 cycles, the intensity of the pulsations is only one-half.

As illustrated, 50-cycle current having a frequency differential of 2 beyond the primary shutter frequency of 48, with a resultant pulsation rate of 2; and 60 cycles having a differential of 12 and a resultant pulsation frequency of 12; and 72 cycles having a differential of 24 and a resultant pulsation frequency of 24, it might easily be assumed that as progression is made in the scale of current frequencies the same results would ensue, that is, that a pulsation frequency equal to the differential between the shutter frequency and the arc supply frequency, would continue indefinitely.

TABLE A

Arc Frequency	Pulsation Frequency	Pulsation Intensity
50 cycles	2	81%
60 cycles	12	50%
72 cycles	24	25%
84 cycles	12	10%

If this were true it is obvious that at some point, perhaps in the neighborhood of 82 cycles, there would be a pulsation frequency so rapid as to be imperceptible. This is not the case, however. At an arc current frequency of 72 cycles the maximum pulsation frequency (24 cycles) is reached with a shutter frequency of 48. From a frequency of 72 cycles upward there is a gradual decrease in the resultant pulsation frequency, as is indicated by the analysis of results at 84 cycles.

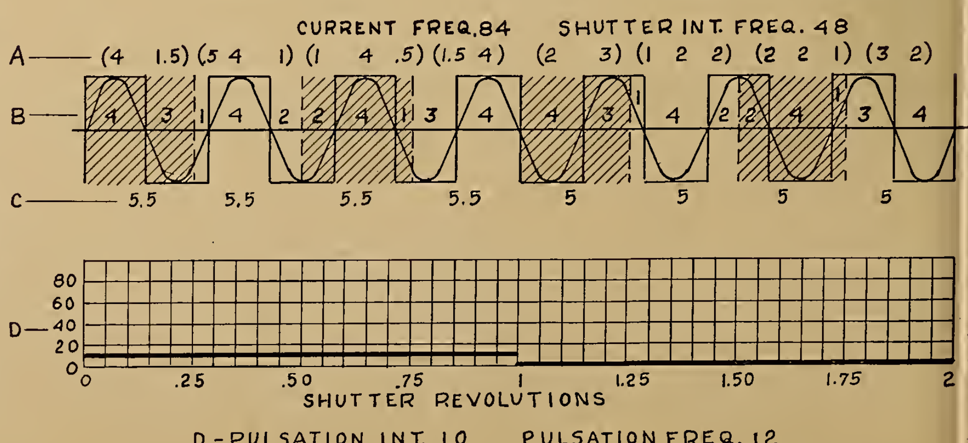
Figure 7 shows the results of superimposing 84-cycle current on the standard 48-cycle shutter graph. During the entire first revolution of the shutter the average light remains at 5.5; but during the entire second revolution the average light value drops to 5; after which the cycle is repeated, producing on the screen a 12-cycle pulsation, the intensity of which is only 10%.

Thus, instead of the pulsation frequency increasing to 36, which is the differential between 84 and 48, the pulsation rate has reverted to 12, or the same rate as was obtained at a frequency of 60 cycles. The intensity of the pulsation instead of being 50%, as it was at 60 cycles, has decreased to 10%. Table A shows the results obtained thus far.

It is evident that as the current frequency is increased, the resultant pulsation rate increases to a maximum of 24 per second at 72 cycles, and then decreases. However, the intensity of the pulsations has continually decreased from the 50-cycle arc supply current. Evidently the assumption that it might be possible to reach a point of imperceptibility through high pulsation frequency must be abandoned. However, there is a point where both the pulsation rate and the pulsation intensity is zero, and complete co-ordination exists between shutter interception frequency and the arc current frequency.

Figure 8 shows an arc frequency of 96 cycles superimposed on the 48-cycle shutter chart. It will be noted that during each shutter opening as well as during each shutter interception a full cycle of light occurs. Not only is the average light value the same but the intercepted light values are also equal to those passed through the shutter openings. This means that no matter what phase differential exists between the arc current and shutter openings, the light values during successive shut-

FIGURE 7

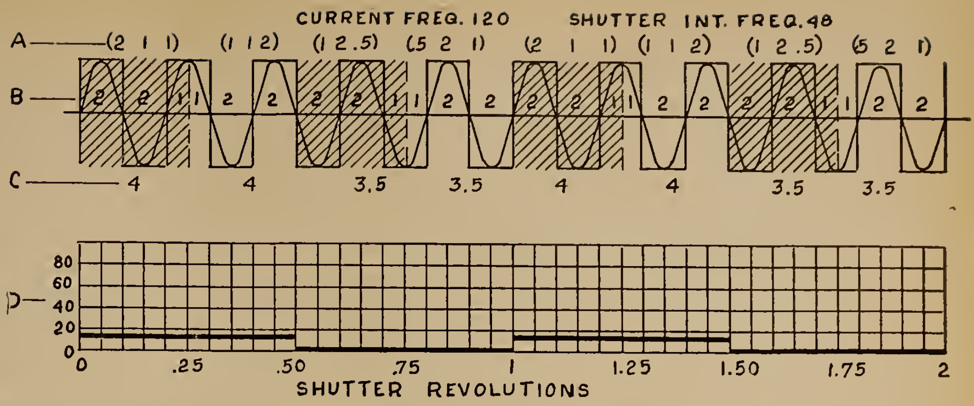


ter openings will be identical and an equal amount of light will always be projected upon the screen. Fig. 8 shows the pulsation intensity to be zero with a consequent pulsation level of zero.

At 96 cycles the exact point of co-ordination of light pulsation values has been reached. At this point phase relation is of no consequence and absolute synchronism between the arc and shutter frequencies is wholly unnecessary. The arc frequency may vary either way from this point, within reasonable limits, without detrimental results; likewise the shutter frequency may vary to a certain extent, as can be deduced from the curve shown in Fig. 10. Here the comparative flatness at the point of contact with the zero line indicates such a low value of pulsation frequency and intensity in the immediate vicinity of the ideal frequency that deviation from that point is entirely practical, within limits.

Figure 9 shows an arc frequency of 120 cycles superimposed on the 48-cycle shutter chart. At 120 cycles the ratio of shutter opening to half-cycle time is 96 to 240, or 2 to 5. The successive light values for each shutter opening are 4, 3.5, 4, and 3.5, showing an increase in intensity of 14.28% and a pulsation frequency of 24 per second, which, of course, is unsatisfactory for motion picture projection.

Figure 10 shows what I have found



D-PULSATION INT. 14.28 PULSATION FREQ. 24

FIGURE 8

to be the values of pulsation frequency and pulsation intensity over a range of supply current frequencies of from 48 to 208 cycles, when the light is intercepted 48 times per second by a shutter having diametrically opposed blades and two light openings of substantially 90 degrees each.

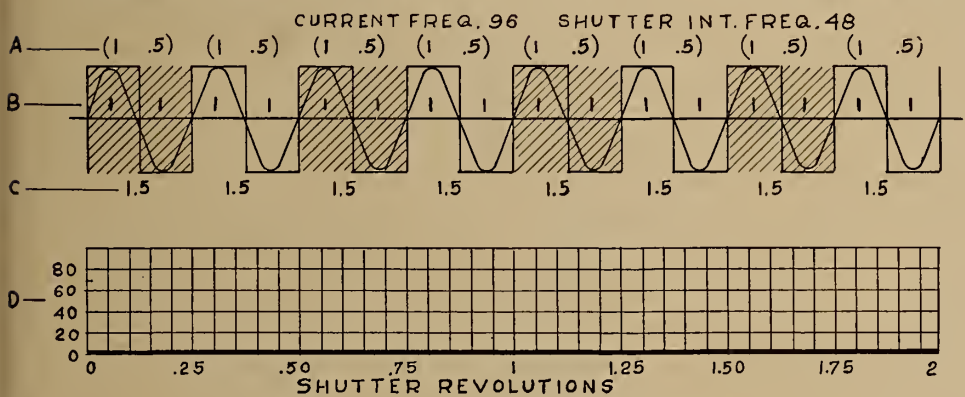
The pulsation intensity as illustrated is the result obtained when a value of 1 is given to the alternation acting upon the carbon facing the reflector, and .5 to the alternation acting upon the carbon facing away from the reflector. The vertical lines represent the frequency of the arc supply current; while the horizontal lines, numbered at the right, represent the light pulsation rate in terms of pulsations per second. The horizontal lines, numbered at the left, represent the pulsation intensity in terms of the percent of increase of the maximum intensity over the minimum intensity during one pulsation. The curve shown in dotted lines represents the pulsation frequency; and that shown as a solid line, the pulsation intensity. These curves were plotted from numerous graphs of various frequencies throughout the range shown, and were verified by actual experiments.

These curves show that from 48 to 72 cycles the pulsation rate increases in direct proportion to the increase in current frequency; that from 72 to 96 cycles the pulsation rate decreases in proportion to the current frequency increase; that from 96 to 120 cycles the pulsation rate again increases in direct proportion to the increase in current frequency; and that thereafter the same cycle of increase and decrease in the pulsation rate will occur as the current frequency is increased by a number equal to the number of shutter openings per second.

The intensity of the pulsations, however, continues to decrease from a maximum at 48 cycles to a minimum at 96 cycles as the frequency is increased. At 96 cycles, as shown, the pulsation intensity as well as the pulsation frequency is zero. Above 96 cycles the pulsation intensity again increases and again reaches a maximum at 144 cycles, whereafter another decrease occurs, reaching zero at 192 cycles, or the fourth harmonic, of the shutter frequency.

It will be noted that at the third harmonic, 144 cycles, although the pulsation frequency is shown as zero, there is a pulsation intensity of 25%. This means that, if *exact* synchronism between the shutter speed and the current frequency is maintained an *exact*

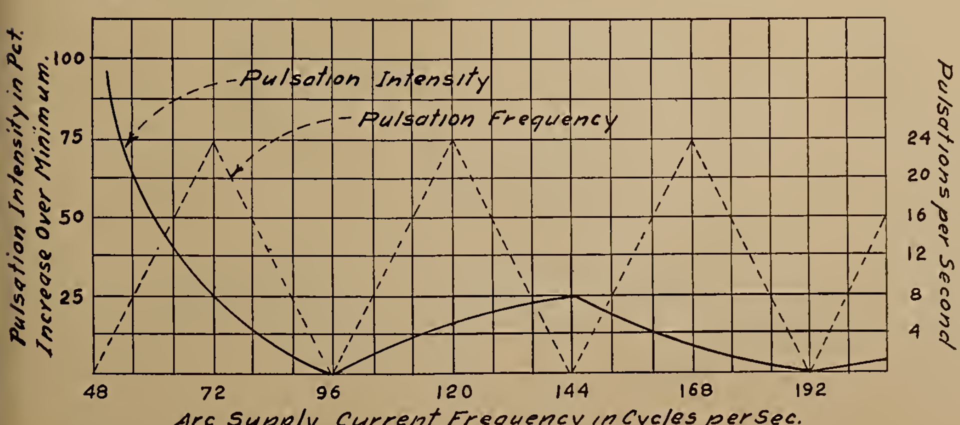
(*Turn to Col. 1, next page*)



D-PULSATION INT. 0 PULSATION FREQ. 0

FIGURE 9

FIGURE 10



S.M.P.E. Convention Program Marked by Advance Technical Data

BIG-TIME engineering activity, rather than practical theatre operating problems, held the spotlight at the Society of Motion Picture Engineers Convention held at Hotel Pennsylvania, N. Y. City, Oct. 16-19. Current progress in many branches of industry technical endeavor, ranging from intricate sound-scrambling machines down through three-dimensional pictures to simplification of the Technicolor photographic process, lent to the Convention an air of futuristic forecasting.

As usual, the Convention afforded an opportunity for many informal discussions among delegates from widely scattered points—luckily for the large projection delegation on hand to whom the program cannot be said to have been of absorbing interest.

At the opening business session it was revealed that, while the Society affairs in general are in excellent shape, the European War has occasioned the loss of not a few foreign members. Society finances are in good shape, it was disclosed, which status was not altered by this latest Convention.

● New Officers Elected

The Convention marked the retirement after years of service of Dr. Loyd A. Jones (Eastman) as Engineering Vice-President; he was succeeded by D. E. Hyndman (Eastman); A. S. Dickinson (Hays office) and James Frank, Jr. (National Theatre Supply Co.) were re-elected financial vice-president and secretary, respectively; R. A. Strock (Eastern Service Studios) was named treasurer, and Dr. A. N. Goldsmith and Herbert Griffin were returned as Governors.

The initial session featured a paper by Dr. S. S. Stevens, Dept. of Psychology at Harvard University. The problems of sound distortion encountered in recording and reproducing and sound for the movies always before have been handled by scientific improvements within the equipment used in the studio and the theatre projection room. Dr. Stevens' researches are an attempt to study the problem from a new angle by discovering what amount of sound distortion is set up within the ear itself.

"By analyzing the minute electrical output of the ears of animals, and by indirect experiment on the human ear, we have been able to measure the amount of distortion produced by the ear itself upon simple sound waves," Dr. Stevens said. "We found that the amount of distortion which the human ear is just able to detect is intimately related to the amount of distortion occurring in the ear itself. Hence, the transmission characteristics of the ear determine the exact tolerances for distortion in sound reproduction."

● N. Y. Production Appeal

Highlight of the get-together luncheon was the address by Mayor F. H. LaGuardia of N. Y. City who suggested the return of at least a portion of picture production to N. Y. City. "This is no typical Chamber of Commerce appeal," said the Mayor, "but is a question posed in all seriousness. N. Y City offers everything that Hollywood does, including location spots, and then some, and in addition it is the undisputed art center of the world. Production certainly would be no cheaper, but N. Y. offers certain advantages not given to any other city in the world." The Mayor said that when in Hollywood he never visited the studios because he desired not to dispel the illusion created by motion pictures by knowing too much "behind-the-scenes" stuff.

The session at the World's Fair grounds on Monday evening included a special after-hours demonstration of RCA television, a showing of two-channel recording and reproducing with steel tape by A. T. & T. engineers, and J. A. Norling's three-dimensional motion pictures at the Chrysler Auditorium.

The Norling described the making of a three-dimensional motion picture on double film with a camera having two polarized lenses, spaced apart to record the composite depth of vision obtained by human eyes. He then distributed polarized viewing glasses to the delegates with which they saw the completed motion picture at the Chrysler exhibit. One of the lenses in the viewing glasses is polarized to admit light vertically, and the other to admit light horizontally, so that each eye sees a

(*Continued on page 27*)

SMPE Speech Gleanings

Highlighting the oratorical efforts at the SMPE Convention were the following significant statements.

By W. G. Van Schmus, managing director of the Radio City Music Hall, largest theatre in the world: "I wonder if you people know how it feels to have 6,000 patrons in an auditorium —and then have the sound go dead. This doesn't happen often at the Hall, naturally, but I confess that it constitutes my greatest fear."

By Mayor F. H. La Guardia of N. Y. City: "I had expected that Mr. Van Schmus would name as his greatest problem the handling of the 72 Rockettes (world famous precision dancers). Even so, I doubt that Mr. Van Schmus knows what real trouble is; and in any event, I hereby offer to trade him 72 Commissioners for the 72 Rockettes."

By Dr. Herbert T. Kalmus, head of Technicolor: "Within one year I predict that Technicolor pictures will be taken in conventional motion picture cameras and with only a single negative film."

W. & V. Circuit Projectionists Guests at SMPE Meet

Duplicating its performance of past years, Wilmer & Vincent Theatres gave additional prove of its sustained interest in good projection work, and also gave other circuits something to shoot at, by bringing to the New York meeting of the SMPE a group of its key projection men. All expenses paid by the circuit, of course.

The W. & V. projectionists in attendance at the Convention, under the guidance of Supervisor Henry Behr, were Frank Sutton, Norfolk, Va.; Otis E. Bugg and F. M. Armstrong, Richmond, Va.; Stewart Seifert and Charles Seifert, Easton, Pa.; Harold Conrad and Jim Rau, Allentown, Pa.; Leroy Talbot, Reading, Pa.; Paul F. Patterson, Harrisburg, Pa.; and Charles E. Brunner, Altoona, Pa.

Credit for this intelligent managership move is due and hereby extended to General Manager J. D. Eagan of W. & V. Sidetrips to various places of interest were arranged for the group, including a visit, under the guidance of P. A. McGuire, to the International Projector Corp. plant.

CYCLEX PROJECTION SYSTEM

(*Continued from preceding page*)

phase relation between the sine waves of the current supply and the shutter openings is maintained, there will be no flicker; but if the current should alter or the shutter opening shift by as much as 90 degrees, there would be a pulsation with a light change of 25%. Such an arrangement of synchronism and phase maintenance is entirely impractical.

Around 96 cycles and 192 cycles, there is a band of frequencies which allow a considerable latitude of variations and in which the arc can be operated without the necessity of mechanically or electrically interconnected means of interlocking for maintaining definite speed relations. It is in the lower range that Cyclex is operated due to the simplicity of frequency conversion to this range.

Quality Changeover Aids By Strong

Made by a Projectionist for Projectionists!

Reel-End Signal

Does not touch the film or reel.

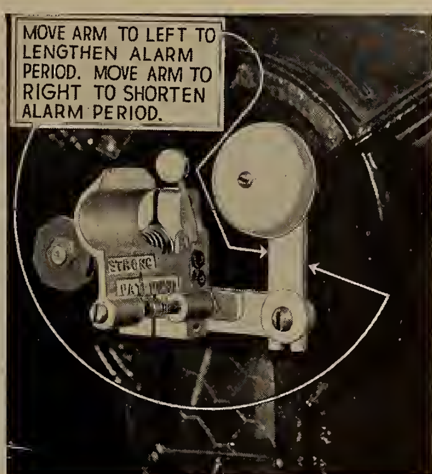
Is strictly mechanical and requires no batteries, no transformers, no governors, and no pre-setting by the projectionist.

Is not dependent upon any change in the normal smooth operation of the projector.

Is installed within 5 minutes, requiring no drilling.

Once installed, forget it—as was conclusively demonstrated by 1200 tests under practical conditions in various projection rooms.

About 75 seconds before the end of the reel the bell begins to ring, continuing distinctly for 15 seconds, after which period of time it ceases. The duration of the bell-signal can be increased or decreased about 15 seconds by simply moving the arm to either the left or the right.



The Strong Reel-End Signal Is

Adjustable

for Either 4- or 5-inch Hubs

PRICE: $8.50 each

Zipper Changeover

ZIPPER Changeovers for all models mount directly on the projector at the aperture and can be installed within 10 minutes without any drilling or tapping, etc., and require no brackets! A new-type treadle foot-switch, utilizing an unbreakable mercury switch, eliminates all switch trouble. Weighs only 20 ounces; guaranteed against trouble for one year after purchase.

The combination Sound-Vision Changeover is now available in all ZIPPER models for use with any RCA sound installation. This method of changeover is EXCLUSIVE with the STRONG ZIPPER, being fully covered under U. S. Patent No. 1,796,970. These combination models for RCA systems are priced at $125 per pair, including foot-switches.

ZIPPER Changeovers available for Simplex (all models) Motiograph (all models) and Kaplan projectors.

●

PRICE ON ALL MODELS

$60 per pair

With Treadle Mercury Switches: $75

ESSANNAY ELECTRIC MANUFACTURING CO.

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1241 South Wabash Ave. Chicago, Illinois, U. S. A.

Color Film Screen Values†

By *W. C. HARCUS*

TECHNICOLOR M. P. CORP., HOLLYWOOD, CALIF.

The color intensity of a motion picture projection system may affect the presentation of the picture. Using sample comparison methods the average color of projection systems can be determined and the deviation of a particular system measured.

CONSIDERABLE data have been collected and published concerning motion picture screen illumination from the standpoint of intensity. There is very little information concerning the color of projection systems. A projection system includes the light-source, optical system, and screen. The color of the light-source may vary from the yellow of a "Mazda" lamp to the blue-white of a high-intensity arc. The quality and condition of the elements of the optical system will affect the color of the light leaving the projector. The color of the light reflected from the screen will be affected by its type and condition.

A rapid and simple comparison method of determining the color of the system by measurement of the light reflected from the screen has been developed. The equipment used consists essentially of a light-source of adjustable color and intensity and a power-supply unit. The variable light-source consists of a slide-film projector unit equipped with a 500-watt "Mazda" lamp, a lens with iris diaphragm, and a filter holder mounted in front of the lens. The power-supply unit consists of an autotransformer with an output range up to 130 volts when supplied with 115-volt, a-c power. A voltmeter and ammeter are wired into the unit which also serves as a support for the projector.

Auxiliary equipment includes a set of "Daylight Blue" filters ranging in thickness from 0.04 to 0.10 inch in steps of 0.01 inch, a white "standard screen," and a set of colored reflection screens. The technic of making a screen-color measurement with the "comparator" is essentially as follows:

● Measurement Procedure

(1) Set up the standard screen as near the center of the projection screen as practicable.

(2) Set up the comparator in front of the screen and adjust the beam so that it just covers standard screen.

(3) Operate the projector system, and erect a mask to shield a small standard screen from the light-beam.

(4) Insert a suitable filter in the comparator and adjust the intensity to match that of the projector system.

(5) Refine the color match between the standard screen and the screen being measured by adjustment of the filters, and record the filter thickness.

(6) An alternative method employs tinted screens instead of a white-screen-and-filter combination. The procedure is essentially the same.

Interpretation of the results of comparative measurements may be in arbitrary units, such as filter thickness, which in turn may be translated into other units as desired.

● Wide Projection Range

A number of measurements have been made with the comparator in East and West Coast theatres, and in many of the Hollywood studios. Analysis of the data indicates that there is appreciable variation in color of projection systems. The average system color may be reproduced with a 0.13-inch "Daylight Blue" filter in the comparator; deviations of ±0.03 inch in thickness from the 0.13 average are found.

†J. Soc. Mot. Pict. Eng. (XXXIII) Oct. 1939.

DISCUSSION

MR. CRABTREE: How does this variation in color affect audience reaction? That is the only way we can estimate the importance or seriousness of this variation in screen color. Have you made any audience tests?

MR. HARCUS: Not in the sense in which you are thinking, I believe. In viewing a picture on the screen, whether black-and-white or colored, the viewer, unless the color deviation is very marked, may not notice the difference in terms of neutral gray in the case of black-and-white, or the color variation in the case of a colored picture. If the deviation is very marked the difference becomes very objectionable.

MR. HOOPER: What kind of instrument do you use to determine the color of the light on the screen in case you want to get any particular color?

MR. HARCUS: We are using this type of comparison unit with which the color of the screen is matched, as demonstrated.

MR. HOOPER: Do you have any instrument with which to measure the color-temperature of the light on the screen?

MR. HARCUS: We have not yet undertaken any studies to that extent.

MR. CARLSON: Does the range of color difference shown here represent an acceptable range? Do you have any means of measuring screen brightness rather than incident light? In several instances where a balance presumably was demonstrated, differences in brightness seemed to be apparent. Was that due possibly to the fact that the photocell is not color-corrected and due to the selective reflectivity of the screen itself?

MR. HARCUS: There is the degree of difference we have observed here. I believe this represents a greater deviation than is desirable for the presentation of either black-and-white or colored pictures. The meter we use for this type of work is a simple Weston meter. This is a photoelectric type of meter and measures the light falling on the screen. It is not accurately color corrected so far as color-sensitivity of the eye is concerned.

MR. KELLOGG: I take it from your answer to Mr. Crabtree's question that the audience is not very critical of the color and that if the color source did vary over a certain range the audience would not criticize it. If that is the case, I do not quite see the purpose of making this rather exact study.

For color projection do you find a still greater premium on very high screen brightness than you need for black-and-white pictures and do you get more return psychologically from high brightness in the case of color than you do black-and-white?

Ten ft.-candles 'Average' Screen

MR. HARCUS: The purpose of the initial investigation was to determine the average screen color of the many theatres we encounter. This was to be determined as a control for the manufacture of color pictures. Color pictures that look the best on the "average screen" may not look quite so good on screens that deviate from the average.

We find in terms of light falling on the screen, that the average large motion picture screen does not exceed 10 foot-candles by any substantial amount. We have found some running as high as 13 and a few as high as 18 or 20. We have found some as low as 5 foot-candles at the center of the screen. We manufacture color pictures to show to the best advantage on an average screen of 10 foot-candles.

MR. RICHARDSON: In lighting for color photography we have a problem quite similar to the one here under consideration. The requirements of color photography rather closely limit the spectral quality of the sources used on the motion picture set. Until we devised a

(*Continued on page* 25)

The Fundamentals of Mathematics

By *GEORGE LOGAN*

SOUND DEPARTMENT, METRO-GOLDWYN-MAYER STUDIOS

Conclusion: Logarithms.

It will be a help if the reader digest each article as it appears, for the ideas presented in subsequent sections hinge upon an understanding of topics discussed in earlier sections. Further, it is desirable that the issues of this series be cached away after reading, as back-reference may be useful before the series is completed.

THERE is with me the vague recollection of reading, long ago, that logarithms were first exposed by some ancient Scottish doctor. I'm not going to check on this, so I'm probably inviting a barrage of contradictions. Nevertheless, that thought as to their origin sticks with me, and as a result I've always had the latent impression of a logarithm being a kind of bug, a sort of benevolent bacillus, if you please.

The very word "logarithm" heightens this connotation; it has a biological sound to my ears. If imagination be allowed to run bersekedly rampant, one can just picture a grizzled old Scot medico, surrounded by pickled things in bottles, his gnarled knees showing under kilts, perched over a microscope and peering at something wriggling on a glass slide—lo! . . . a logarithm.

A logarithm's anatomy is made up of two and *only two* components a *body*, called the *mantissa* (not *mantilla*, that's something Spanish gals wear); and a *head*, called the *characteristic*. The *mantissa* is always positive. But the *characteristic* is wilfull, and may be positive or negative. A logarithm is a pretty straightforward bug when his *characteristic* is positive; but he's apt to be a little treacherous when he shows up with a negative *characteristic*.

Never mind. We'll isolate him and show his workings in both forms. We'll take a good inoculatory shot of logarithms in the following discussions and wind up, we hope, invulnerable to any mystery they have exhibited in the past.

Supplementing the needle, better dig out that cobwebby table of logarithms gathering dust on the shelf. A pencil and pad will be handy too. First of all, what is a logarithm? The definition is arbitrary, and resolves from giving names to the perfectly general algebraic expression: $b^x = n$

Here x is defined as the logarithm of n to the base b. Stating it in another way, the logarithm of a number to a given base is the power to which the base must be raised to produce the number.

From this it is apparent that logarithm tables could be produced for practically any base: say, $b = 1$, $b = 2$, $b = 3$, and on, and on. Actually, however, the work of creating such tables would be superfluous, for mathematicians have found that only two bases are necessary for the handling of problems: logarithms to the base 10 comprise one system; logarithms to the base 2.71828 comprise the other.

Logarithms to the base 2.71828 are called *natural* logarithms, and are used principally in higher mathematics—calculus, hyperbolic functions, and sundry other headaches. Logarithms to the base 10 are called *common* logarithms, which soubriquet is well chosen, for they are the most commonly used for numerical calculations. For that reason we'll confine our microscopic study to the species $\log_{10}$ and postpone research on $\log_{2.71828}$ to some future scribbing.

With our jottings thus far you should be able to partially build up a common logarithm table yourself, assuming you were out in the woods, remote from one, and couldn't think of anything better to do in the woods. As a starter, what is the logarithm of 1? Stymied? Well, we know that:

$$b^x = n$$

And that our base, b, is 10, and that our number, n, is 1. Hence: $10^x = 1$.

The power (logarithm) to which 10 must be raised to produce 1 is zero. Hence x, the logarithm of 1 to the base 10, is zero, for: $10^0 = 1$.

Following the same procedure the logarithm of 10 is found to be 1.00000, for:

$$10^{1.00000} = 10$$

Carry on in this wise and you'll find that the logarithm of 100 is 2.00000; the logarithm of 1000 is 3.00000; and the logarithm of 10,000 is 4.00000. Each of these complete logarithms is composed, as has been mentioned, of two parts: a *characteristic* and a *mantissa*. The portion of the logarithm to the left of the decimal point is the *characteristic;* the portion to the right is the *mantissa*. From this little trial shot at building a logarithm table certain deductions are naturally drawn, my dear Watson. These are:

The characteristic *is an integer of magnitude one less than the number of digits to the left of the decimal point in the number whose logarithm is sought.*

The mantissa *depends only on the sequence of digits in the number, and does not depend in any way upon location of the decimal point in the number.*

Thus the *mantissa* is an independent sort of bug, and it doesn't give a tinker's expletive whether the number whose logarithm is sought is, for example, 7734 or 77.34, the *mantissa* is the same for each. Consequently, logarithm tables give simply the *mantissas* for particular sequences of digits. And the table leaves it up to you to prefix the *mantissa* with the proper *characteristic*, blandly assuming you know the rule for determination of the characteristic.

Suppose we take the sequence 9875, progressively sprinkle it with decimal points, and find the complete logarithms for the numbers resulting:

No.	*Characteristic (from inspection)*	*Mantissa (from table)*	*Complete Log*
9875	3	.99454	3.99454
987.5	2	.99454	2.99454
98.75	1	.99454	1.99454
9.875	0	.99454	0.99454

Now let's carry on with this decimal-point-moving still further. The next step gives us the number .9875. Here we must pause to write another general rule:

When the number whose logarithm is sought, is entirely a decimal, the characteristic *of the logarithm is negative. Further, the magnitude of the* characteristic *is one plus the number of zeros between the decimal point and the first digit in the number which is not zero.*

Application of this rule gives us —1 as the *characteristic* of the logarithm of .9875. Negative *characteristics* are preferably written with the minus sign above, thus $\bar{1}$, for the minus sign

applies to the *characteristic* alone and not to the *mantissa.*

We've gone forward, and we're now able to write the logarithms of any wholly decimal numbers:

No.	*Characteristic (from inspection)*	*Mantissa (from table)*	*Complete Log*
.9875	$\bar{1}$	.99454	$\bar{1}.99454$
.09875	$\bar{2}$	.99454	$\bar{2}.99454$
.009875	$\bar{3}$	.99454	$\bar{3}.99454$
.0009875	$\bar{4}$	.99454	$\bar{4}.99454$

Right now is a propitious moment to digress a whit, take a new test tube off the shelf, smear a slide and, peering through the 'scope, take a good look at a logarithm's close blood relation—*antilogarithms.* Every logarithm has an aunty. Up to this point we've started with a number, and from the tables and inspection found the complete logarithm of that number. Finding the antilogarithm is the reverse procedure.

It's easy. Suppose you have the logarithm $\bar{2}.81298$. Take a look at the *mantissa,* go to the tables and find the sequence of numbers in the antilogarithm is: 6501.

Now look at the *characteristic,* $\bar{2}$. The little minus-sign bonnet indicates the antilogarithm is wholly decimal, and the magnitude of the *characteristic* shows that there is one zero between the decimal point and the first digit which is not a zero. Hence the complete antilogarithm may be written: .06501.

For the sake of good measure, let's tabulate several logarithms and their kinfolk. It might be a good hunch to place a card over the antilogarithms tabulated below and find them yourself from the table. If your antilogarithms agree with mine—well, your antilogarithms agree with mine.

Logarithm	*Antilogarithm*
1.65706	45.40
$\bar{3}.98318$	.00962
4.20276	15950.
0.57066	3.721

So much for the essential nature of logarithms and antilogarithms, and how to find them. Now the thing to tackle is how to use the critters. Logarithms may be used for:

1. Obtaining the value of the product of numbers.
2. Obtaining the value of the quotient of numbers.
3. Obtaining the value of a number raised to any power.
4. Obtaining the value of any root of a number.

The rule for finding the product of numbers is this: *The logarithm of the product is equal to the sum of the logarithms of the individual numbers to be multiplied.* Writing this rule symbolically we get:

$$\log [(N_1)(N_2)(N_3)] = \log N_1 + \log N_2 + \log N_3$$

For a specific example, find the product (772) (.906) (2.45).

$$\begin{aligned} \log 772. &= 2.88762 \\ \log .906 &= \bar{1}.95713 \\ \log 2.45 &= 0.38917 \\ &\overline{3.23392} \end{aligned}$$

Look up the antilogarithm of 3.23392 and you have the product. But on trying to find the *mantissa* .23392 in the table you'll run smack into a snag: you'll find *mantissas* close to it. There is .23376, corresponding to the sequence 17130; and there is .23401, corresponding to the sequence 17140. Thus we surmise, and correctly, that the sequence of our antilogarithm lies between 17130 and 17140. For the time being we are ignoring the location of the decimal point in our antilogarithm, considering the sequence of numbers in it alone.

Organizing what we have, and calling the unknown and desired sequence *S*:

Sequence	*Mantissa*
17130	.23376
S	.23392
17140	.23401

The numerical difference between two sequences is proportional to the numerical difference between the corresponding *mantissas.* Hence, from simple proportion we can write:

$$\frac{S - 17130}{17140 - 17130} = \frac{.23392 - .23376}{.23401 - .23376}$$

Solving this we get $S = 171364$. Spotting our decimal point from inspection of the *characteristic,* 3, our product is 1713.64.

The foregoing operation employing proportion is known as *interpolation.* Before leaving interpolation we should also consider the case where the unknown is the *mantissa* instead of the sequence. For example, find the *mantissa* of 18254. The *mantissa* for the sequence 18250 is obtainable directly from the table, as is also the *mantissa* for the sequence 18260; but the *mantissa* for the intermediate sequence 18254 is not given, and must be obtained by interpolation.

Tabulating as before, but this time with *M* the unknown:

Sequence	*Mantissa*
18250	.26126
18254	*M*
18260	.26150

Again, from simple proportion, we write:

$$\frac{18254 - 18250}{18260 - 18250} = \frac{M - .26126}{.26150 - .26126}$$

Solving, we obtain $M = .261356$.

So much for interpolation. Comes now division by logarithms. The rule is: *The logarithm of the quotient is equal to the logarithm of the divisor subtracted from the logarithm of the dividend.* In general terms:

$$\log \frac{N_1}{N_2} = \log N_1 - \log N_2$$

Let's start with an easy example. Find the quotient of 8472 divided by 25.01.

$$\begin{aligned} \log 8472 &= 3.92799 \\ \log 25.01 &= 1.39811 \\ &\overline{2.52988}, \text{ from subtraction} \end{aligned}$$

The quotient is the antilogarithm of 2.52988, which is interpolated to be 338.75.

That was easy because the *characteristics* are both positive, and the *mantissa* of the dividend is larger than the *mantissa* of the divisor, enabling us to subtract the latter from the former without fuss or feathers. But the following problem in division is a little more intriguing. Find the quotient of .2501 divided by 84.72.

$$\begin{aligned} \log .2501 &= \bar{1}.39811 \\ \log 84.72 &= 1.92799 \end{aligned}$$

To handle this, add and subtract 10 to the *characteristic* of log .2501. This is permissible, for you can add 10 to something, then subtract 10, and you haven't changed the value of that something. Performing this operation gives:

$$\begin{aligned} \log .2501 &= 9.39811 - 10 \\ \log 84.72 &= 1.92799 \\ &\overline{7.47012} - 10, \end{aligned}$$

from subtraction

$$\text{Thus } \log \frac{.2501}{84.72} = 7.47012 - 10 = \bar{3}.47012$$

The antilogarithm of 3.47012 is

Pic Biz Ills No. 7241

Request from U. S. exhibitors that Paramount withdraw from radio programs such stars as Bing Crosby and Jack Benny, whose air appearances the exhibs charged hurt film business terrifically, was met by bland statement from Paramount that since the popularity of these stars was originally built up on the air the producing company was unable to do anything about it.

.002952; in other words, .002952 is the quotient of .2501 divided by 84.72.

Without further ado let's leave division and consider the method of raising a number to a power. The rule is: *The logarithm of a number raised to a power is equal to the power (i.e. exponent) times the logarithm of the number.* Writing this rule in general symbols:

$$\log N^x = (x)\ (\log N)$$

Taking as a specific example the problem $(6794)^{2.3}$, we write:

$$\begin{aligned} \log\ (6794)^{2.3} &= (2.3)\ (\log 6794) \\ &= (2.3)\ (3.83213) \\ &= 8.81390 \\ \text{hence}\ (6794)^{2.3} &= \text{antilogarithm of } 8.81390 \\ &= 651{,}483{,}333 \end{aligned}$$

Following is another example, a little more difficult. Find the value of $(.065)^{1.5}$:

$$\begin{aligned} \log\ (.065)^{1.5} &= (1.5)\ (\log\ .065) \\ &= (1.5)\ (\bar{2}.81291) \end{aligned}$$

You can't multiply by 1.5 directly, for the logarithm is composed of a negative and positive term, the *characteristic* and *mantissa*, respectively. The way to handle this is simply to multiply the *characteristic* and *mantissa* separately by 1.5, and add the products, thus:

$$\begin{aligned} (1.5)\ (\bar{2}) &= \bar{3}. \\ (1.5)\ (.81291) &= \frac{1.21936}{\bar{2}.21936} \\ \text{hence}\ (.065)^{1.5} &= \text{antilogarithm of } \bar{2}.21936 \\ &= .0016572 \end{aligned}$$

To wind up the whole subject there remains only the topic of roots to entertain. The general rule is: *The logarithm of the root of a number is equal to the logarithm of the number divided by the index of the root.* Writing this in general symbols:

$$\log \sqrt[x]{N} = \frac{\log N}{x}$$

Suppose we have, say, $\sqrt[3]{1941}$:

$$\begin{aligned} \log \sqrt[3]{1941} &= \frac{\log 1941}{3} \\ &= \frac{3.28803}{3} \\ &= 1.09601 \end{aligned}$$

$$\begin{aligned} \text{Hence: } \sqrt[3]{1941} &= \text{antilogarithm of } 1.09601 \\ &= 12.474 \end{aligned}$$

That's straightforward enough. But we have to proceed in a specialized manner when the *characteristic* is negative. As an example, find the value of $\sqrt[1.1]{.49}$.

$$\begin{aligned} \log \sqrt[1.1]{.49} &= \frac{\log .49}{1.1} \\ &= \frac{\bar{1}.69020}{1.1} \end{aligned}$$

We can't divide directly because the numerator is made up of two terms of opposite sign. The "out" is to add negative units or parts of units to the *characteristic* which will make it evenly divisible by the index of the root; and add the same number of positive units or parts of units to the *mantissa*. Divide those sums separately by the index of the root. The quotients are the Characteristic and Mantissa, respectively, of the logarithm sought:

$$\text{Characteristic} = \frac{\bar{1}. + \bar{.1}}{1.1} = \frac{\bar{1.1}}{1.1} = \bar{1}.$$

$$\text{Mantissa} = \frac{.69020 + .1}{1.1} = \frac{.79020}{1.1} = .71836$$

$$\text{Hence: logarithm of } \sqrt[1.1]{.49} = \bar{1}.71836$$

$$\begin{aligned} \text{Hence: } \sqrt[1.1]{.49} &= \text{antilog of } \bar{1}.71836 \\ &= .52282 \end{aligned}$$

With that, you can pull the cover over your microscope, place the hypo needle back in its case, unlimber your smock, and hope the injection "takes".

(THE END)

LOCAL 37 REGAINS AUTONOMY

Coincidentally with announcement of a 10% tilt in pay for I. A. cameramen was the news of the return of local autonomy to Local 37, comprising studio workers, the largest single I. A. unit. Local 37 reassumes jurisdiction over studio electricians (whose Local 728 is now disbanded) and will have concurrent jurisdiction over prop makers and miniature men now in Local 44. John F. Gatelee, I. A. representative on the Coast for months past, has returned East.

Causes, Effect, Aid for Electric Shock

Electric shock may be divided into two broad classes: those due to current from a continuously operating source, and those due to current from a sudden discharge. First, the current from a continuously operating source will be considered. These sources include power lines, whether a.c. or d.c., transformers, rectified power supplies after the initial contact, *etc.*

The most commonly accepted causes of death from electric current may be divided into three classes. First, the current may cause the heart or brain to lose its power to react to a stimulus. Second, metabolism in the body may be so accelerated that the blood is deprived of its supply of oxygen, and asphyxiation results. Third, sudden violent muscular contractions may cause fatal hemorrhages in various parts of the body especially in the brain.

● The Danger Line

Artificial respiration* may be effective in restoring life in the first two instances and especially in the second. The first two causes result usually from more or less prolonged passage of current, while the third is usually the result of a sudden heavy current. The path which the current takes determines to a large extent the effect on the body. A path through the heart is usually much more dangerous than other paths.

The current which may safely be passed through the body depends on the frequency. Frequencies of 50 to 150 cycles are the most dangerous. Direct current is considered to be equivalent to a.c. at 350 cycles. The human body readily tolerates the following for considerable periods of time: 8 ma. at 60 cycles, 30 ma. at 11,000 cycles, 800 ma. at 100,000 cycles, and 3,000 ma. at 1,000,000 cycles.

While there is no close agreement by various investigators in the field, some sort of weighing of the available information would lead to the conclusion that 75 ma. of 60-cycle current and 150 ma. of d.c. should be considered as a dividing point between safe and dangerous currents. The resistance which the human body presents to an electric current depends largely on the skin resistance and hence on the type and area of contact. In general it varies between 5,000 and 100,000 ohms in actual cases with something of the order of 30,000 ohms being average.

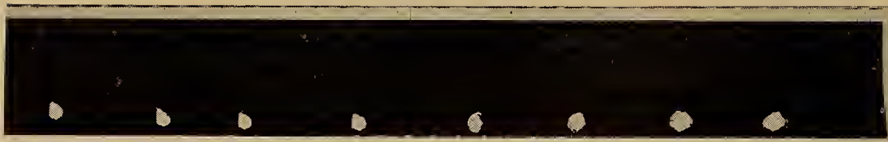
Direct current usually kicks the subject away from the circuit; while a.c., especially at frequencies around 60 cycles, causes the subject to cling tighter to the circuit. Prolonged contact with the circuit usually causes more and more current to pass due to the breaking down of skin resistance. Above 50,000 cycles the muscular contractions disappear.

In 1934 the census of the United States showed that 442 people were killed by lightning and 723 by electric currents in that year. Insurance companies state that 50 per cent of electric accidents are fatal.

Danger from condenser charge has not been very well investigated. An early investigator found 400 joules fatal to a 1-pound guinea-pig and concluded that the number of joules in the charge were more important than the voltage or initial current.—*Communications.*

*For the proper procedure to follow in case of a severe shock, readers are referred to "Resuscitation from Electrical Shock," by C. B. Desoto, p. 16, Feb., 1939, *QST*.—*Editor.*

Punch Marks? Let Them Be Artistic



To the Editor of I.P.

ONE of our theatres recently returned for our attention some clippings they had taken out of a film then running. Although this film was a re-issue and over a year old, it is our personal opinion that the original changeover cue marks in all probability would have served their purpose as adequately as when the film was originally released.

However, some motion picture surgeon apparently decided to remove the tonsils or the adenoids, or possibly both, or the epiglottis of the original cue marks, by the simple process of punch holes. In addition to which, he must have left a sponge in

Typical example of modern technique in the use of a punch—plus knife marks. Recommended as a great aid to entertainment value.

the anatomy, as he had to make four additional openings to find his lost working tools. I have taken the trouble of having a paper print made of this gorgeous sample of the artist's work. The smaller section of film is an even better example of what the depraved mind can conceive when addicted to destroying the Academy's cue marks.

You will note that there are several different types of destructive marks indicated attesting to the ingenuity of the various motion picture engineers who subjected this print to laboratory experimentation.

Many and Varied Marks

For instance, the center portion was punched with a conductor's punch—and a pretty shape it is, too. The next exponent of the arts decided to scratch the emulsion from the film around the outside of the punch mark. This did not please the third artist, who painted a partial white ring around the perforation in an effort to obscure the previous artist's work. The result of the whole is a beautiful piece of heterogeneous hieroglyphics approximately ¼" in diameter, which when multiplied on a 20-foot sheet will probably equal about five to six feet in diameter. This no doubt added greatly to the patrons' enjoyment of the picture, as they probably thought that this was the scene where the great producer had introduced lightning.

On the smaller sample there has been painted what appears to be a pre-historic monster; and we feel quite sure that this also added to the patrons' enjoyment. We deeply sympathize with the poor projectionists who feel that the Academy has been very niggardly in not providing sufficient changeover cue marks, nor cue marks large enough to further annoy the audience. It might even be better, perhaps, if the Academy had specified twenty-four of these cue marks.

But we do take issue with these particular projectionists in that if we are going to have to look at punch marks, we would prefer something in the nature of a heart shape, or diamond or spade, or at least something of a more artistic nature, so that if the public must see them, at least let us appeal to their more artistic sense. In other words, you can have them—we don't want them.

M. D. O'Brien
Projection Dept., Loew's Theaters

Automatic Curve Tracer New RCA Service Aid

THE frequency response characteristics of audio amplifiers and the effects of various amplifier circuit adjustments may now be more easily and conveniently observed through the use of an automatic curve tracer developed by RCA Photophone. When used in conjunction with an audio oscillator or other signal generating device, this instrument traces the response curve of the amplifier under test on the "long persistent" screen of an RCA 910 cathode ray tube. The intensity and duration of the visible trace are sufficient to permit several curves to be superimposed on the screen for comparison or photographing.

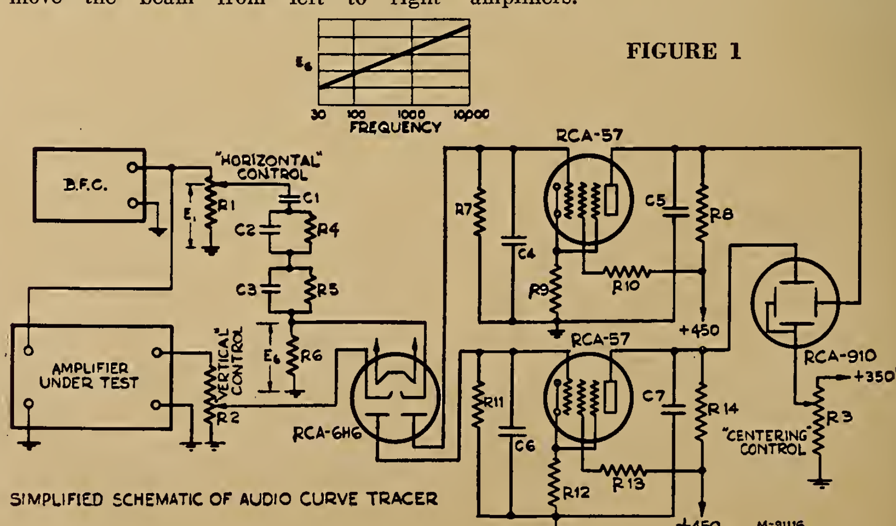
The source of audio signal is fed into a discriminating network, shown in Fig. 1 as C1, C2, C3, R4, R5, and R6. The characteristics of this network are such, that with a constant voltage E1 impressed across the network, the voltage developed across R6 varies directly as the logarithm of the frequency impressed. This is shown in the small curve in Fig. 1.

The voltage E6 is impressed across the diode section of the RCA-6H6 tube and is rectified. This rectified signal is amplified and impressed across the horizontal plates of the RCA-910 cathode ray tube. The effect of this voltage on the electron beam is to move the beam from left to right across the screen as the frequency of the audio source is increased from zero upward throughout the audio range.

By rectifying and amplifying the output signal from the amplifier under test and impressing this d.c. voltage across the vertical plates of the cathode ray tube, the beam is deflected vertically in accordance with the output level at the particular frequency under observation. The combination of the two deflection voltages results in the audio frequency curve of the amplifier being traced on the screen as the audio signal is varied throughout the audio range. Because of the long persistent characteristic of the RCA-910 screen, the trace is held long enough for observation or photographing.

A two stage amplifier is also incorporated in the instrument so that the low level output of a soundhead as used in theatre sound reproducing equipments can be amplified and used as the signal generator. A continuously variable frequency test film being run through the soundhead as a source of signal. The instrument is completely a.c. operated, portable, and self-contained. It is particularly useful in making production and service tests on audio frequency amplifiers.

FIGURE 1



SIMPLIFIED SCHEMATIC OF AUDIO CURVE TRACER

Technicolor Adventures In Cinemaland†

By *HERBERT T. KALMUS*
PRESIDENT, TECHNICOLOR MOTION PICTURE CORPORATION

An account of some of the highlights in the history of the development of the business of Technicolor Motion Picture Corp., incidental to which is an account of the development and growth of the various Technicolor processes from a semi-technical point of view but with special reference to practical application in the motion picture industry. This paper won the SMPE Journal Award for the best paper published therein during the year.

WEBSTER defines adventure as *chance of danger or loss; the encountering of risks; a bold undertaking, a daring feat; a remarkable occurrence or experience, a stirring incident; a mercantile or speculative enterprise of hazard; a venture.* The excursions of Technicolor into the domain of the producers, distributors, and exhibitors of motion pictures have been all of these.

Early in the development of any color process, two decisions of policy must be made: first, how far will it permit departure from standard equipment and materials, and, second, how will it attempt to divide the additional requisites of recording and reproducing color between the emulsion maker, the photographic and laboratory procedure, and the projection machine. Technicolor assumed at the outset that special cameras and special projectors were permissible, provided raw film of standard dimensions were employed.

The earliest Technicolor laboratory was built within a railway car. This car was completely equipped with a photochemical laboratory, darkrooms, fireproof safes, power plant, offices, and all the machinery and apparatus necessary for continuously carrying on the following processes on a small commercial scale: sensitizing, testing, perforating, developing, washing, fixing and drying negative; printing, developing, washing, fixing and drying positive; washing and conditioning air; filtering and cooling wash water; examining and splicing film; and making control measurements and tests.

In 1917 the car was rolled over the railway tracks from Boston, Mass., where it was equipped, to Jacksonville, Fla., where the first Technicolor adventure in feature motion picture production was to take place. The camera was the single-lens, beam-splitter, two-component type, without the refinements which came later. The picture was *The Gulf Between*, with Grace Darmond and Niles Welch playing the leads. Technicolor was the producer. The process was two-color, additive, standard-size frame, and hence demanded a minimum of the laboratory procedure.

During the progress of this production, February, 1917, I was invited by the American Institute of Mining Engineers to deliver a lecture at Aeolian Hall, N. Y., to expound the marvels of the new Technicolor process which was soon to be launched upon the public and which it was alleged by many could hardly do less than revolutionize their favorite form of entertainment.

The Gulf Between had been preceded by *The Glorious Adventure*, a feature picture made in England by the Kinemacolor Process. Since Kinemacolor photographed the color components by successive exposure, it was nothing for a horse to have two tails, one red and one green, and color fringes were visible whenever there was rapid motion.

The Technicolor slogan was two simultaneous exposures from the same point of view, hence geometrically identical components and no fringes. At that time hundreds of thousands were being spent by others trying in impossible ways to beat the fringing of successive exposures and the parallax of multiple lenses.

Projector Attachments Taboo

I thought the Technicolor inventors and engineers had a practical solution, commercial at least temporarily, so I marched bravely to the platform at Aeolian Hall. It was a great lesson. We were, of course, introducing the color by projecting through two apertures, each with a color filter, bringing the two components into register on the screen by means of a thin adjusting glass element. Incidentally, Technicolor had to invent and develop a horizontal magnetically controlled arc which gave one-third more light for the same current than the then-standard vertical arcs and which could be relied upon for constancy of position of the source. This latter was vitally important with a double aperture.

During my lecture something happened to the adjusting element and, in spite of frantic efforts of the projectionists, it refused to adjust. And so I displayed fringes wider than anybody had ever before seen. Both the audience and the press were very kind, but it didn't help my immediate dilemma or afford an explanation to our financial angels.

Arrangements were made with Messrs. Klaw and Erlanger to exhibit *The Gulf Between* by routing the photoplay one week each in a group of large American cities. During one terrible night in Buffalo I decided that such special attachments on the projector required an operator who was a cross between a college professor and an acrobat, a phrase which I have since heard repeated many times. Technicolor then and there abandoned additive processes and special attachments on the projector.

As early as 1918 Technicolor had in mind two principal methods of attacking the color problem. Dr. Leonard T. Troland, who, at the time of his death, was Director of Research of Technicolor, had done some important pioneer work on the Monopack process. The other Technicolor attack was by the imbibition method. Both Monopack and imbibition were obviously capable of ultimate development into multi-component processes, but since imbibition seemed to load more of the problems on the laboratory and relatively less on the emulsion maker, we pursued it with the greater vigor.

A first approximation to the Technicolor imbibition method consisted of two gelatin reliefs produced upon thin celluloid which were glued or welded together back to back and dyed in complementary colors. Combined with the Technicolor two-component cameras, this method provided an immediately available system (1919-21) capable of yielding two-component subtractive prints. A small laboratory or pilot plant was built in the basement of the building occupied by the Technicolor engineers, Kalmus, Comstock & Wescott, Inc., on Brookline Avenue, Boston, Mass.

First Subtractive Feature

In 1920 Judge William Travers Jerome first became interested in Technicolor; he brought as associates the late Marcus Loew, Nicholas M. Schenck, now President of Loew's, Inc., and

† J. Soc. Mot. Pict. Eng., XXXI (Dec. 1938).

Joseph M. Schenck, now Chairman of the Board of 20th Century-Fox, Inc.

Both Joseph and Nicholas Schenck have on many occasions been most helpful to Technicolor by giving practical advice to Judge Jerome and to me, but at no time more so than when it was decided to produce the photoplay which was later called *The Toll of the Sea*. This was the first Technicolor production by the subtractive method.

Nicholas Schenck arranged for the release of *The Toll of the Sea* by Metro-Goldwyn-Mayer. The first showing was given at the Rialto Theater in New York, the week of November 26, 1922. Letters of praise were received from Maxfield Parrish, Charles Dana Gibson and other artists. But because of insufficient laboratory capacity we were not able to supply prints fast enough to follow this up immediately and not until 1923 was the picture generally released in the United States. It grossed more than $250,000, of which Technicolor received approximately $165,000. The prints were made in the original plant in Boston at a manufacturing cost of about 27 cents per foot.

Every step of the work in *The Toll of the Sea* was carefully watched by the executives of the industry. Rex Ingram, who was in the midst of producing *Prisoner of Zenda*, wired Mr. Loew for permission to scrap everything he had done in black-and-white on that picture and start over again in color. D. W. Griffith wanted to produce *Faust*, and Douglas Fairbanks telephoned about producing a feature.

Our first adventure in Hollywood seemed successful! We were told that with prints as good as we were manufacturing it offered at 8 cents per foot the industry would rush to color.

But, thus far we had made only inserts and one feature production. We had no adequate means of giving rush print service in Hollywood, and we were charging 20 cents a foot for release prints. It was another matter to convince a producer to employ the Technicolor company to photograph and make prints of a production at his expense and risk and under the conditions which prevailed in the motion picture industry.

Meanwhile Tcchnicolor Plant No. 2 was being built in Boston in a building adjoining the one containing the Pilot Plant. It had a capacity of about one million feet per month and cost approximately $300,000. In April, 1923, a small Technical laboratory and a photographic unit was established in a building in Hollywood rented for the purpose.

In November, 1923, Jesse L. Lasky and I finally agreed upon the terms of a contract between Technicolor and Famous Players Lasky Corp. for the production of *The Wanderer of the Wasteland*. We were told that they had appropriated not more for this picture than they would have for the same picture in black-and-white. Also that the time schedule allowed for photographing was identical with what it would have been in black-and-white. The photography was to be done by our cameras in the hands of our technical staff, but following a budget and a time schedule laid out for them by Famous Players. Rush prints and the quality of negative were to be checked by them each day.

During the six weeks of photography our entire staff worked from early morning to late at night, including Sundays and holidays. At one time we were accumulating negative which we did not dare to develop because of inadequate facilities in our rented laboratory. A few of us in Technicolor carried the terrorizing thought that there was no positive assurance that we would finally obtain commercial negative, and that the entire investment might be lost. However, Mr. Lasky was not permitted to share that doubt. His confidence and help during the darkest hours were really marvelous; and finally the cut negative emerged satisfactorily.

We delivered approximately 175 prints which were shown in several thousand theatres over the country. These prints were billed at 15 cents a foot, for which Technicolor received approximately $135,000. Some of these prints were made in the pilot plant, but more of them were made in Plant No. 2, which was now being run by operators we had trained.

Obstacles to Volume

Nevertheless there were reasons why we could not obtain a volume of business. Every producer in Hollywood knew that our first important production under actual motion picture conditions and not controlled by Technicolor had just been completed by Famous Players. A considerable group of producers expressed themselves as interested, but were waiting to see the outcome. Another group believed the process to be practical and might have paid our then price of 15 cents a foot, but considered it impracticable to send the daily work to Boston for rush prints.

A small plant, primarily for the purpose of developing negative, making rush prints, and providing a California headquarters was installed at 1006 North Cole Avenue, Hollywood, in a building erected for our purposes. A large part of the equipment was built by our engineers in Boston and shipped to California. The installation was ready for operation about the middle of the year 1924.

Neither *The Toll of the Sea* nor *The Wanderer of the Wasteland*, nor any of the inserts made until the middle of 1924 had given us experience photographing with artificial light. We were therefore very glad to obtain an order for an insert in a production directed by George Fitzmaurice, called *Cytherea*, photographed in the United Studios lot in Hollywood, giving us our first experience in photographing an interior set on a dark stage. Mr. Fitzmaurice was delighted with the results. In the Fall of 1924 we had six men and

NEW W. E. 31A H-F HORN

A single horn, designated as the 31A, which does the work of four trumpet-type loudspeakers in distributing upper-register sound in the horizontal plane has been announced by Western Electric. Because of its novel design, sound radiation from the new horn is substantially uniform over 120 degrees horizontally and 40 degrees vertically. This distribution characteristic enables sound engineers to provide uniform coverage in even the widest auditoriums and to eliminate such disagreeable conditions as "overlap." The relatively narrow vertical beam tends to reduce reflection from the ceiling.

Either of two W.E. loud speaking receivers may be used with the new horn. When used with the 549A receiver, a frequency range extending from 400 to 10,000 cycles per second is reproduced. When so equipped, the new horn lends itself ideally as the high-frequency element of a two-way loudspeaker for high fidelity work. The 31A horn may also be used as an announcing speaker. For this purpose it may, by means of a special

fixture, be equipped with a type 707F receiver. It will then reproduce all frequencies between 400 and 6,500 cycles per second.

The new horn is cast of aluminum in one piece, measures approximately 23″ wide by 9″ high and 15″ deep. It weights 9½ pounds and is suitable for either indoor or outdoor use.

four cameras working in Rome on the M-G-M production, *Ben Hur.*

One of the great adventures of Technicolor and a milestone in its progress was in the photography, print manufacture and exhibition of Douglas Fairbanks' *The Black Pirate.* Mr. Fairbanks had the idea that the screen had never caught and reflected the real spirit of piracy as one finds it in the books of Robert Louis Stevenson, or the paintings of Howard Pyle, and that he could catch it by the use of color. He said:

"This ingredient has been tried and rejected countless times. It has always met overwhelming objections. Not only has the process of color motion picture photography never been perfected, but there has been a grave doubt whether, even if properly developed, it could be applied, without detracting more than it added to motion picture technic. The argument has been that it would tire and distract the eye, take attention from acting, and facial expression, blur and confuse the action. In short it has been felt that it would militate against the simplicity and directness which motion pictures derive from the unobtrusive black-and-white. These conventional doubts have been entertained, I think, because no one has taken the trouble to dissipate them. A similar objection was raised, no doubt, when the innovation of scenery was introduced on the English stage—that it would distract attention from the actors. Personally I could not imagine piracy without color . . . ."

But Mr. Fairbanks' attorneys pointed out that this production would cost a million dollars, and asked what assurance there was that Technicolor would be able to deliver prints, much less satisfactory prints. This difficulty was finally resolved by making a tripartite agreement in which the engineering firm of Kalmus, Comstock & Westcott, Inc., which still had the pilot plant in the basement of its building, agreed under certain conditions that it would deliver the prints in case Technicolor failed.

There was great discussion as to the color key in which this picture would be pitched. We made test prints for Mr. Fairbanks at six different color levels, from a level with slightly more color than black-and-white, to the most garish rendering of which the Technicolor process was then capable. Mr. Fairbanks set to work on the shore of Catalina Island and off that shore on his pirate ship, with four of the seven Technicolor cameras then in existence, to capture moods after the manner of impressionistic painting.

The picture was released through United Artists in 1925. So far as audience reaction, press reviews, and box-office receipts were concerned, it was a triumph from the start, but for the Technicolor company it was a terrible headache.

Technicolor was still making the double-coated cemented together relief prints, so that the red and green images were not quite in the same plane, and the pictures didn't project too sharply on the screen. This double-coated film is considerably thicker than ordinary black-and-white film, with emulsion on both sides which tends to make it cup more readily and scratch more noticeably than black-and-white film. And the cupping could occur in either direction, more or less at random. Judging from the complaints, at each such change in the direction of cupping, the picture would jump out of focus.

We sent field men to the exchanges. We provided these men with a supply of new prints to replaced the cupped ones in the theatres, in order that the latter might be shipped back to our laboratory in Boston for de-cupping. The newly de-cupped prints were temporarily satisfactory; the picture was a great success, but our troubles never ended.

It had been clear that this double-coated process was at best but a temporary method, and the work of developing a true imbibition process was being pressed in our research department. But unfortunately the imbibition process was not ready for *The Black Pirate,* or for *The Wanderer of the Wasteland.*

Early in 1925 Sydney R. Kent, then head of distribution for Famous Players, said: "We have concluded not to do more Technicolor pictures for the present, for two reasons: first, because we have had a great deal of trouble in our exchanges due to the fact that the film is double-coated and consequently scratches much more readily than black-and-white, with the necessity of having to order more replacements, and it is an added bother to our operators; and, second, because the cost is out of all proportion to its added value to us. We paid $146,000 additional for *Wanderer* prints. We understand that you need volume to get your costs down. At an 8-cent price we would be interested to talk volume."

Evidently Technicolor needed the single-coated imbibition prints and volume to lower the price to meet his conditions. Meanwhile Nicholas Schenck, then President of Loew's, Inc., was advising us to produce a picture ourselves, to prove both quality and costs.

And so in 1926-27 I once more found myself explaining to the directors of Technicolor that I always had believed and still believed very thoroughly in the ultimate success of the Technicolor project, always provided, however, that it was recognized by the directors to be a tremendously difficult undertaking

Forest Adds New Suprex Lamp to Projection Line

FOREST, INC., adding to its already extensive line of projection equipment, will introduce on Nov. 1 a new Suprex arc lamp (simplified high-intensity). Complete details of this new product, not yet available, will be announced in the next issue of I. P.; but the following outline of features is presented herewith:

1. Completely new patented arc feed. Positive and negative feed mechanism are entirely separate. This is a novel feature completely overcoming existing feed troubles.

The feeding speed of the positive carbon can be adjusted accurately without in any way affecting the feeding speed of the negative carbon, allowing independent accurate adjustment of each, thus keeping the arc in exact focus with the optical system at all times.

2. Manual feed handles do not turn as carbons are being automatically fed by motor. The automatic and the manual feed both operate without counter pressure, friction devices, clutches, springs or chains.

3. Lamp will burn any low-intensity trim or any Suprex trim without change of carbon holders. Thus this is an all-purpose lamp.

4. An automatic stop is provided for each carbon holder, preventing damage to, or burning of, jaws if too short a carbon be used.

5. Floor of lamphouse in front of mirror is completely clear of all mechanism, thus preventing copper and carbon dust from falling into mechanism, and making for ease of cleaning. There is nothing in front of the mirror except the positive carbon holder.

● Mechanism, Optics, Trim

6. Practically all mechanism is placed back of the mirror and is readily accessible through the door.

7. Electromagnet placed at side of mirror with adjustable arm allowing magnetic influence to be adjusted to suit draft and other operating conditions, which vary in different theatres.

8. Carbon guide is made of non-magnetic, highest melting point material obtainable.

9. Reflector mirror by Bausch & Lomb insures excellent screen illumination. Reflector can be adjusted or tilted in any direction, and in addition can be adjusted backward and forward, for obtaining accurate focus while lamp is operating.

This new lamp is designed to burn any size or type of carbons, thus a new trim giving revolutionary results, to be announced shortly, may be used with great savings and without change of equipment. This lamp is designed to take a larger mirror for faster lenses when available.

Pending the detailed announcement in I. P., additional information anent this development may be had direct from Forest, Inc., 200 Mt. Pleasant Ave., Newark, N. J.

technically and one which requires business sagacity and financial endurance. These directors had had many earlier reminders of the necessity of financial endurance.

(TO BE CONCLUDED)

Erpi-G.T.P. Suit Settled

The litigation, extending over a period of more than seven years, Erpi and the General Talking Pictures Corp., which included patent, anti-trust and damage suits, has been settled according to an announcement made by Erpi. No damage payments were made. Certain expenses of the litigation were apportioned and the only payment made was by the way of adjustment of such expenses.

Erpi obtained rights under patents controlled in the recording and reproduction of sound for motion pictures.

RCA Tube Conversion Kit

RCA Photophone has introduced a new conversion kit which will substantially increase the volume output level of certain types of sound-film reproducing equipments and will also effect a saving of over 70% in photocell replacement cost. The kit consists of three photo-tubes (one for each projector and a spare), a pair of metal brackets with the new tube sockets, and a lens. The kit, which is applicable to the W.E. Universal Base, and 206 and 208 soundheads, permits the use of the RCA 868 photocell in place of the more expensive 3A and similar types of cells.

New Garver L-I Rectifier

A new 15- to 30-ampere capacity rectifier for low-intensity operation, which supersedes the standard Garver Kurrent Changer, has just been introduced by Garver Electric Co., Union City, Indiana. Features include an improved winding and a higher grade steel which assure greater efficiency, longer bulb life and a smoother performance. Unique natural draft cooling is obtained through the new case design, which is said to further increase the overall efficiency.

Local 110 School Rates

I. A. Local 110, Chicago, has advised principals of all public schools that the following scale will prevail for projectionists engaged for film shows at which admission is charged: for any three consecutive hours, minimum charge, $7.50; two shows between 9 a.m. and 1 p.m., $10; two shows, one in a.m. and one in p.m., $12.50.

L. U. 306 SUES CIRCUITS

Suits have been instigated by N. Y. Local 306 against RKO, Loew, Warner and Paramount theatre circuits in the area within the union's jurisdiction asking for restoration of a 10 per cent wage cut granted by the Local to the theatres when Sam Kaplan was president of the union.

Suits claim that when the Local granted the wage cuts, which were at the request of the theatre interests, restoration of the cut within one year's time was agreed upon, and the theatre circuits have failed to fulfill their part of the agreement.

B. C. MANPOWER RULING

British Columbia projectionists and exhibitors quarrel of long standing 'settled' by Provincial Govt. ruling that only one projectionist is required for all theatres open 40 hours or less per week. While this applies only to smaller theatres in Province, it means a serious manpower loss, such houses having previously used two-men shifts. Union plans to fight ruling.

NEW DETROIT DEALER CO.

New theatre supply company is being organized in Detroit as the Acme Theatre Supply Co., by Joseph S. Renick and Thomas Napoletano, at 131 W. Vernor Highway.

McCAUL TO CANADA A. F.

William McCaul, projectionist at the Broadway, Toronto, has enlisted in the Royal Canadian Air Force. He served in the Army Medical Corps in the World War, having enlisted when he was 17.

FEDERAL TAX TAKE UP; HOUSE BUILDING SPURT

Federal admission tax collections in September touched the highest point of the year so far at $1,852,256, an increase of more than $338,000 over the $1,513,468 collected in August and approximately $183,000 over the $1,668,827 recorded in September, 1939, it was reported by the Internal Revenue Bureau.

Theatre building and major remodeling has taken a marked upturn, with the first nine months of this year recording a volume nearly $1,500,000 greater than in the same period in 1938 in the 37 states east of the Rockies.

The favorable margin was brought about by steady gains over 1938 in the past three months, and the sluggish activity has definitely ended.

SHARP VAUDEVILLE RISE

While various key spots throughout the U. S. are dispensing with flesh acts in favor of straight film fare, the trend generally reflects a sharp upturn in the use of vaudeville. Booking offices in N. Y. City report a 60% increase in flesh shows all over the country, with the Manhattan area figure being about 40%.

N. Y. C. CIRCUIT GAINS

Skouras Theatres of N. Y. City reports an upturn in patronage of about 40% over the corresponding period last year. Rise attributed to the run of current big pictures plus a noticeable decrease in unemployment.

BUFF DIES IN MACON

J. F. Buff, 48, president of Local 507, Macon, Ga., died suddenly recently. Active in Labor circles and several times v.-p. of Georgia State Federation of Labor, Buff was a familiar figure at numerous I. A. conventions.

ALTEC-DOM. SOUND PACT

Agreement covering the reciprocal interchange of technical information pertaining to sound reproducing and other theatre equipment and servicing techniques has been signed by Altec Service Corp. and Dominion Sound Equipments, Ltd., of Montreal, Canada.

S.R.P. LEADER REVISION?

The Research Council of the Academy of M. P. Arts and Sciences has formed a committee to consider possible revisions for the specifications for the S. R. P. leader. The present leader was revised in August, 1936, simultaneously with adoption of the Standard 2000-foot reel. The committee will study these specifications with a view to recommending changes which may improve the leader and facilitate its use by projectionists.

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French theatres, faced with a serious

manpower shortage because of the war, are training women to take over the duties of projectionists called to the colors. No reports on aptitude as yet.

• • •

Add reasons for poor Summer theatre business in Southern New England: Narragansett Race Track closed a 30-day Summer meet Sept. 16, during which a total of $11,509,549 passed through pari-mutuel windows, for an average daily handle of $383,652. On the last day of meet $567,235 was chalked up on mutuel machines.

• • •

Effective now the N.B.C. will present a new television schedule: will immediately add one evening program a week and later a second, so that in a short time one daytime and one evening show will be available five days a week.

Set Heavy Afternoon Sked

Daytime programs, under the new plan, will be telecast five afternoons a week—Tuesdays through Saturdays—starting at 2:30 o'clock. Studio variety hours, including short film subjects, will be telecast on the Tuesday and Friday matinees. Outdoor events will fill the Wednesday, Thursday and Friday periods.

Evening studio programs will continue at the present hour, four times a week, Tuesdays through Fridays. Two of these will continue as dramatic hours; the other two will be variety presentations.

COLOR FILM SCREEN VALUES

(*Continued from page* 16)

qualitative instrument for measuring the spectral distribution of light-sources, we had only our eyes with which to make comparisons. In lighting for color photography, we have a very satisfactory reproducible standard in the *M-R Type* 90 high-intensity arc lamp using a 13.6-mm. carbon operating at 120 amperes with 57 volts across the arc.

Before we devised our comparison instrument, we had to go through an elaborate routine of photographic testing whenever a new unit was under development, in order to adjust the arc voltage and amperage of the unit to give a proper balance in the light. The instrument consists of three small G.E. light meters assembled in a light-tight box, each before a window provided with an adjustable shutter. Each of the windows carries a color-separation Wratten filter—one green, one red, one blue.

Procedure For Instrument Use

We use the instrument comparatively, first setting the shutters to give equal readings of 50 foot-candles through the three filters from our standard *M-R Type* 90 light-source; then readings are taken on the source under examination, and a comparison is obtained. We choose the 50-foot-candle readings as standard because the small G.E. light meters had been selected to read equally in this position. Having separate readings through each of the separation filters, we are able to study the light-source under examination and explore for the conditions that will bring it most nearly to the standard required.

We use this instrument qualitatively through the development of our Duarc, and it may be of interest that our observations made with the instrument corresponded very well with the photographic check results made in the Technicolor

laboratories. We do not use the instrument quantitatively, although if it were more carefully developed, it might be arranged for quantitative color measurements. The instrument could probably be developed to analyze screen brightness and be of particular value for studying screens and light-sources used in the projection of color motion pictures.

Mr. Zurich: What have you found to be the best type of projection screen for Technicolor work?

Mr. Harcus: I am sorry to say I can not answer that question. We take the equipment just as it comes, and your question has not been part of the study.

Mr. Zurich: If you take anything from a dirty bronze yellow to a dark blue on the various screens, the color will show up very well on certain screens and with certain projected light and not so well under other circumstances. Surely there must be some "average" screen.

Mr. Harcus: A screen that is clean and white will certainly present a picture of any type much better than one that is off color or one that is not clean.

Mr. Zurich: If the light from tbe various lamp houses ranges from a dirty bronze yellow to a dark blue, in addition to having a dirty screen, that is something to consider.

Mr. Harcus: That is what we are trying to simulate. We have this device, which has enabled us to determine the average screen color in the average theatre.

Measuring Standard Lacking

Mr. Zurich: We all face the need today for an instrument that will measure the light reflected from the screen—one that we can take into our auditoriums and measure the reflective quality of the screen as well as the color-temperature. This will give us a standard that we do not have today.

Mr. Harcus: That is right. I believe that some instruments have been developed which may soon become available.

Mr. Richardson: In England there was at first a very heavy import of American carbons for use in Technicolor photography and projection. One English manufacturer has undertaken the problem of supplying the English market with suitable carbons for photographing Technicolor pictures and has approached the problem in a very scientific way. They have developed an instrument that would almost exactly meet the need you mentioned. In England the air is foggy and there is considerable soot in the atmosphere.

Screens deteriorate quite rapidly. These English carbon manufacturers have developed an instrument for installation in the projection room which integrates the screen illumination and enables the projectionist at periodic intervals to check his screen and each projection lamp against the optimum performance that was established when the screen was new or was re-surfaced. This instrument would meet the requirements mentioned by Mr. Zurich.

Mr. Joy: In regard to this instrument that Mr. Richardson referred to, I believe that it does give some indication of the total relative light on the screen but it does not take into consideration the distribution of the light, that is, the relation of the light at the sides to the light at the center or the color of tbe light. One of the things we bave found time and time again in our own tests is tbat if we do not take into consideration the distribution of light, the total light reading is often misleading and does not necessarily give a true comparison.

Projection Committee Endeavors

Mr. Griffin: The Projection Practice Committee is trying to get an instrument that will indicate when the screens are deteriorating. We are not primarily interested, for this purpose, in an instrument tbat will give the light distribution. We simply want to be able to determine what tbe brightness is and when the screen needs changing or resurfacing.

We have not been able to find any such instruments other than illuminometers like the Macbeth, where one must read the brilliancy of a target or otber surface. Instruments of this type are expensive,

and apart from that it is difficult to get two men to agree on identical readings. We want an instrument that is definite in results, simple to operate, and with which comparisons can be made from time to time, beginning when screens are first installed and periodically thereafter.

MR. RICHARDSON: The English instrument referred to is designed especially for that, and is intended to be used in the projection room. In England there are fewer of the small theatres which we designate as neighborhood theatres, of which we have so many in this country, but in their larger theatres they can afford to install this instrument which gives such complete information.

MR. JOY: Getting back to Mr. Harcus' paper, is the small comparison screen that you use a standard color or are these sheets of colored paper that you used standard color sheets?

MR. HARCUS: It is a white target screen made from a white cellulose board. The colored screens are manufactured to match certain screens that we have encountered. They vary as to their content of blue, blue-green, and magenta, and represent white closely when reflecting mazda light.

MR. GARBER: Has there been set up any standard of screen brightness?

Projection Group Recommendations

MR. GRIFFIN: The Projection Practice Committee, after some years of studying the problem, have submitted a recommendation to the Standards Committee. As a recommended practice it has been suggested that 7 to 14 foot-lamberts be the range of screen brightness, with no film in the projector and with the shutter running. It is a matter of selecting the proper illuminant behind the film and the proper optics to obtain the best result.

MR. HARCUS: The instrument that Mr. Richardson has described is essentially a camera with a very sensitive photographic cell mounted in focus behind the lens. The cell is wired to a calibrated meter which can be mounted in front of the projectionist.

MR. KELLOGG: About the desirability of high illumination, Mr. Harcus said that an effort was made to make the Technicolor film to project satisfactorily with a screen illumination representing what one might expect in the average good theatre. Presumably that is a matter of not making the prints so dense that they will be too dark under those conditions. Would the same picture look still better if projected with higher illumination?

MR. HARCUS: My personal opinion is that any good print will show to better advantage on a brighter screen. A print that will show to good advantage on a 10-foot-candle screen will show to better advantage on a brighter screen. A print made to show to best advantage on a 2-foot-candle screen would probably be "burned up" at higher illumination.

SMPE PROGRAM MARKED BY ADVANCE TECHNICAL DATA

(*Continued from page* 14)

slightly different image, which when communicated to the brain together become a composite scene of amazingly natural perspective.

"An ordinary two-dimensional picture does not depict the scene as both eyes see it, but only as one eye does, "said Mr. Norling. "When looking at a subject each eye sees a different view. For that reason, an ordinary single lens is incapable of recording the two dimensions of a scene or object. To achieve three-dimensional pictures we must approximate the spacing apart of the human eyes, at the recording end, and devise some means of viewing these two disparate images so that they will appear as one. These effects have been successfully achieved by a special camera with double lenses, and by polarized viewing lenses that bring separate images to each eye".

● Intricate Sound-Scrambling

Following a laboratory session on Tuesday morning, at which the densitometry devotees enjoyed a field day the pleasures of which are denied to mere engineers, the S.M.P.E. delegates met in joint session with the N. Y. Electrical Society at the latter body's auditorium for a demonstration of "Vocoder" (short for voice coder) the big brother of "Voder," which thrills

visitors to the A. T. & T. exhibit at the World's Fair by creating human speech.

"Vocoder" actually "codes" the words, expressions and tones uttered by a speaker or singer, in such a way that all sorts of "tricks" may be performed on human speech, and on vocal as well as instrumental music. It will also create intelligible speech out of non-speech sounds. While differing fundamentally from the famed "Voder," which is controlled by keys and pedals "played" by an operator, the "Vocoder" stems from the same research into the possibilities of creating human speech synthetically. The newest development is entirely voice-controlled.

A man whispers in the direction of an innocent-looking contraption and is greeted by a shattering roar—his own voice. He tries roaring back, and hears his words as a whisper. In desparation he tries singing, only to find that the machine has created another voice which accompanies him in a duet. He is mystified and impressed. The "Vocoder" was spoken to in measured cadences, with the voice raised and lowered in meaningful expression; the voice coder produced every word in a flat monotone. Then a voice with rising inflection, used in anger or excitement, was spoken into the instrument; the "Vocoder" replied in a contrasting descending inflection. A few bars of a popular song were sung as a solo, and the "Vocoder" actually accompanied the singer in a duet. Instrumental music was played, and the amazed audience heard vocal music reproduced.

● **Projection Happenings**

The Projection Session featured the report of the Projection Practice Committee, which detailed progress being made on various projects now under consideration, notably that relative to means for accurately measuring screen illumination, particularly of color prints. Dr. A. N. Goldsmith, prominent motion picture, radio and television consultant presided at the session and also contributed a paper dealing with the future of projectionists.

As not infrequently happens when projection is discussed, there was a recurrence of uncomplimentary remarks anent the shortcomings of projectionists. One comment detailed how upon the occasion of a visit to a projection room both projectionists (who, incidentally were also Local Union officials) were found off in a corner of the room listening to a radio. Another speaker observed that the so-called best jobs were handed out to inferior craftsmen.

Just how these matters come to be mentioned at a projection session of an engineering society is difficult to

understand; but the response was immediate. Said P. A. McGuire, of International Projector Corp.:

"Constructive criticism is alright in its place, but in this instance neither the criticism of the craft nor the place selected in which to voice it is appropriate. In many years of association with various groups, including projectionists, I have always elected to praise the many able men rather than criticize the few delinquents. The Convention records of this Society are mute testimony to the fine cooperative and unselfish efforts of the great majority of projectionists to improve their craft's standing.

"I am mindful of the many projectionists who, with little or no encouragement from industry management, attend these sessions on their own time and expense in an effort to better themselves and in turn to elevate craft standards. I need mention only a few such men: the late Arthur Gray of Boston, Chauncey Greene of Minneapolis, George Edwards of New York, Thad Barrows of Boston, Victor Welman of Cleveland, Frank Dudiak of West Virginia, and Theodore Hover of Ohio. In this room at this very moment are more than a score of men who have done exactly the same thing—and without benefit of expense money from any parent company. This, I believe, in itself constitutes a complete refutation of such critical observations of the craft as have been voiced here."

● Exchange Weak Link—Rubin

Harry Rubin, director of Projection for Paramount, contested vigorously the assumption that inferior craftsmen usually are awarded the best posts, and that there has not been marked progress by the craft in the past ten years. "In any trade one can find delinquents if one diligently sets out to track them down," said Rubin. "Projection work is no exception to this general rule, of course, but I can say without fear of successful contradiction that no body of craftsmen in any line of endeavor could have done better than have projectionists in the past ten years. I have operated a few so-called de luxe theatres in my time, the men for which posts were selected, *and retained,* solely on the basis of performance. I am sure that my colleagues apply the same test to their operations.

"The weakest link in the entire chain of operations, in my opinion, is exchange procedure. I can't honestly say that I have noted any improvement in exchange handling of film for many years past. Film still comes through in a wholly unsatisfactory manner: dirt and oil thereon are pronounced; weak splices abound, indicating little if any inspection, and practically all the provisions of the S. R. P. are ignored. True, we have our problems in projection; but we at least try to do something about them. The exchanges, however, merely acknowledge the existence

of certain undesirable conditions—and then forget them."

The Progress Medal of the Society was awarded to Dr. L. A. Jones of Eastman Kodak Co. in recognition of distinguished service to motion picture technology. To Dr. Herbert A. Kalmus, president of Technicolor, went the Journal Award for the best paper published in the Journal during the preceding year.

Earl R. Morin, of the Conn. State Police (Dept. of Safety) demonstrated a unique fire-control system applicable to an entire projection room and covering the induction of forced ventilation and automatic dropping of ports in case of fire. This system will be described in detail in a subsequent issue of I. P.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933,

Of INTERNATIONAL PROJECTIONIST, published monthly at New York, N. Y., for October 1, 1939.

County of New York } ss.
State of New York

Before me, a Notary Public in and for the State and county aforesaid, personally appeared James J. Finn, who, having been duly sworn according to law, deposes and says that he is the Editor of INTERNATIONAL PROJECTIONIST and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, James J. Finn Publishing Corp., 580 Fifth Avenue, New York, N. Y.

Editor, James J. Finn, 580 Fifth Avenue, New York, N. Y.

Managing Editor, None.

Business Manager, Ruth Entracht, 580 Fifth Avenue, New York, N. Y.

2. That the owner is:

James J. Finn Publishing Corp., 580 Fifth Avenue, New York, N. Y.

James J. Finn, 580 Fifth Avenue, New York, N. Y.

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3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

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JAMES J. FINN, Editor

Sworn to and subscribed before me this 10th day of October, 1939.

(Seal) M. F. HELMSTEADT

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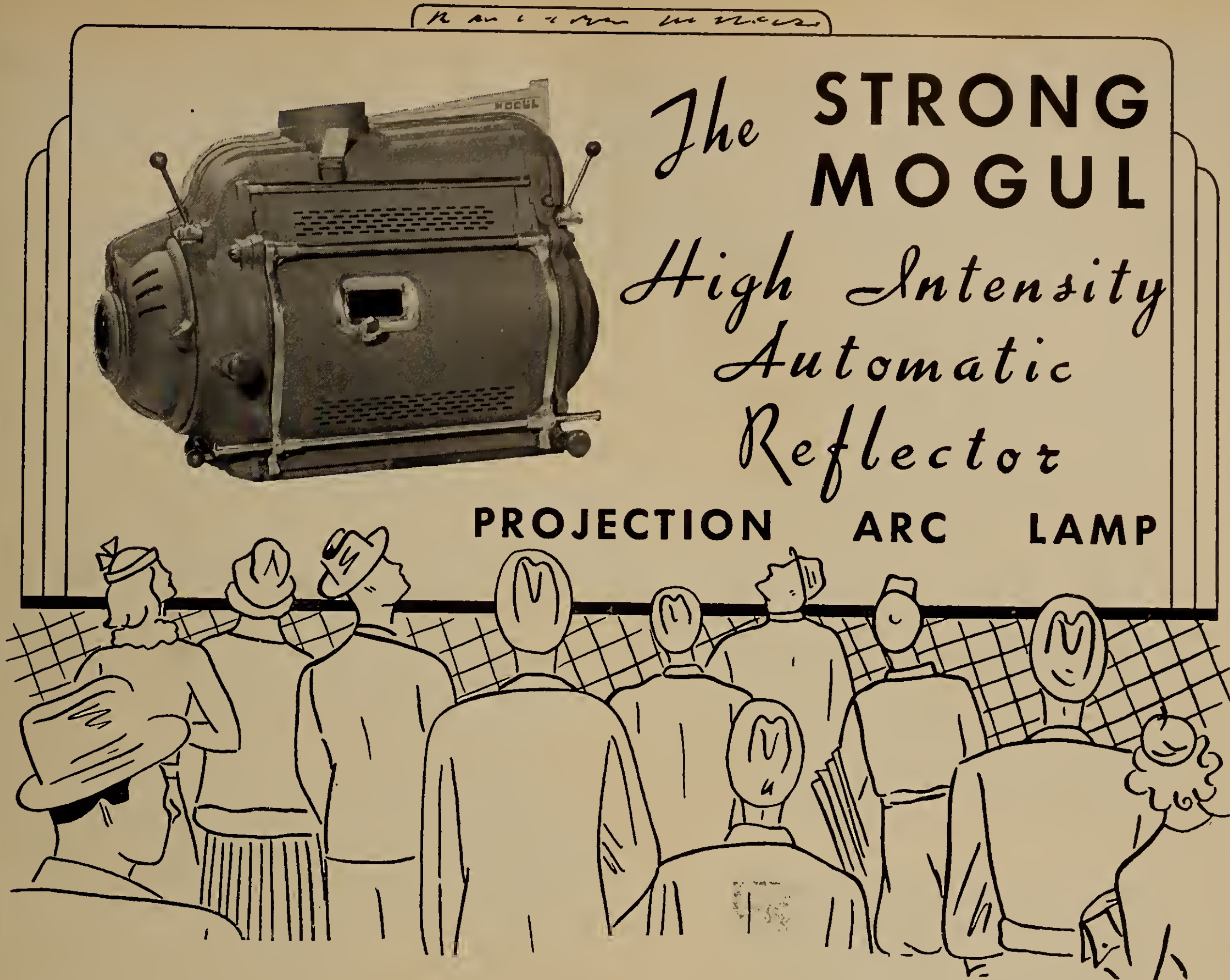

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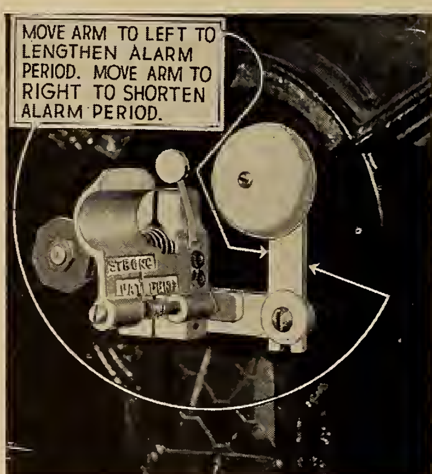

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Edited by James J. Finn

Volume 14 NOVEMBER 1939 *Number 10*

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Monthly Chat

NUMEROUS requests have been received from the field for a down-to-earth summary of the new Ashcraft Cyclex arc, first announcement of which appeared in these columns. I. P. is now assembling this information, which will include *comparative* data, for publication at the earliest possible date. Some idea of the difficulties attendant upon this task may be had from the fact that two eminently qualified independent testing laboratories which have had this equipment under observation for almost two months, are not yet ready to release their findings.

Meanwhile, in accordance with established I. P. policy, a cordial invitation is extended to anybody who has something interesting to say anent this or any other projection development to give full and free expression of their views in these columns at our expense. No worthy enterprise suffers from unhampered open discussion; just the contrary is true.

• • •

Two recent instances of projector trouble induced a revival of the excellent suggestion that all threading jobs be checked by the second man on a shift. One-man shifts must continue to rely upon prayer.

• • •

The medium- and small-sized theatres are the pampered darlings of equipment manufacturers at the moment. The sound system fellows have been pounding at those ramparts for many months past; now the lamp manufacturers are showing rare solicitude for the "little fellow." Cyclex having made its bow, the other lamp manufacturers will have ready almost immediately a new d.c. arc designed to use the 5- and 6 mm. Suprex trim.

Suprex being the prima donna, so to speak, among arcs, the feed controls present the most difficulty. The lamp people say that they have licked this problem. We shall see.

• • •

Anybody who has ever visited a major company exchange must admit that it is a model plant on the score of cleanliness and safeguards against possible loss of life and property as a result of fire. Just why it is that the exchanges do not turn out uniformly good product is difficult to understand. This corner can suggest only two possible reasons for the evident shortcomings of U. S. exchanges: (1) insufficient help, which necessitates speedy work under high tension, or/and (2) insufficient prints.

We'd hesitate to grant complete acceptance to the first premise because we feel that the various exchange workers unions would shortly put an end to any topheavy work schedules. The second premise is much more credible and constitutes a problem which would endure despite the efforts of the most conscientious exchangeman.

INTERNATIONAL PROJECTIONIST

VOLUME XIV NUMBER 10

NOVEMBER 1939

The Effect of P. E. Cell Cable on Sound-Film Reproduction Quality

By *A. R. HAMILTON*
CHIEF ENGINEER, MELLAPHONE CORP.

HUNDREDS of small theatres are now using sound systems which have their complete amplifier mounted on the front wall of the projection room, between the projectors. Photocells are connected to the amplifier by means of shielded cable. The purpose of this article is to explain in simple language the effect this cable has on the quality of the sound.

In order to reproduce good sound, it is necessary that the sound system be capable of amplifying all of the frequencies recorded on the sound track, exactly in their proper proportions, *i.e.*, the input and output should have the same characteristics, differing only in their relative volume.

If a system amplifies the low frequencies to a greater extent than the highs, the sound will be deep, possibly "boomey". Voices will be muffled and not easily understood because the "s's", which consist of high frequencies, will not be brought out. Music will sound unnatural, because the harmonics which give music its quality, are high frequencies which are not reproduced fully.

On the other hand, if the system discriminates against the low frequencies, the result will be "tinny" sound which is not pleasant to hear.

So we see that it is necessary for an amplifier and speaker system to uniformly reproduce all of the frequencies recorded on the track. A great deal of effort and attention has been given to the designing of equipment which will give uniform amplification to all frequencies—that is, flat frequency response.

● P.E. Cell Response

The frequency response of a photocell is very good. There is slight discrimination against very high frequencies, but for sound picture work this is negligible. A well designed amplifier will produce an essentially flat frequency response curve. But when we connect a photocell to an amplifier by means of three or four feet of shielded photocell cable, we find a very definite discrimination against the high frequencies.

Frequencies from 50 cycles to about 800 cycles are amplified in their proper proportion, the p.e. cell cable having no effect in this range. However, frequencies above 800 to 1000 cycles, begin to suffer a loss in transmission through the cable. Frequencies around 5000 cycles suffer so great a loss that there is practically nothing left to amplify. Thus an otherwise good system may have poor overall response, resulting in the poor quality sound previously mentioned.

To explain why a shielded photocell cable causes a loss in high frequencies, requires a little electrical theory, but this will be kept as simple as possible.

Figure 1 shows a conventional photo-reactance is:

$$X_L = 2\pi fL$$

transposing this formula:

$$L = \frac{X_L}{2\pi F}$$

Where *L* is the inductance of the coil

cell circuit. The cell receives a polarizing voltage of 90 volts from within the amplifier. This 90 volts connects to the collecting wire (anode) inside the cell, through a high resistance (p.e. load resistance) usually 1 or 2 megohms. The plate inside the cell (cathode) upon which the light falls is connected, through the metal shield around the p.e. cable, to the negative side of the 90-volt source.

When the cell is dark, its resistance is infinite, and therefore no current will flow. With no current flowing, there is no drop in voltage in the p.e. load resistor (voltage drop = current × resistance: E = IR). Thus the full 90 volts appear across one terminal of the coupling condenser and ground.

When light strikes the cell, however, its resistance decreases to a definite value of, say, 44 megohms. Now we have 90 volts across 44 megohms, plus 1 megohm of load resistance. According to Ohm's Law:

$$I = \frac{E}{R} = \frac{90}{45{,}000{,}000} =$$

.000002 amperes, or 2 microamperes.

The voltage-drop in the load resistor would be:

$$E = IR = .000002 \times 1{,}000{,}000 = 2 \text{ volts.}$$

This leaves only 88 volts across one terminal of the coupling condenser and ground. This change in voltage from 90 to 88 is passed on through the coupling condenser to the first amplifying tube.

● Effect of Shielding

Thus, it is evident that any change in light on the p.e. cell causes a change of voltage to the grid of the amplifing tube. As the sound track passes by the scanning slit, the intensity of the light changes according to the frequency and amplitude of the recording on the track. If this were the whole story, we would expect all frequencies to reach the amplifier in their proper proportion.

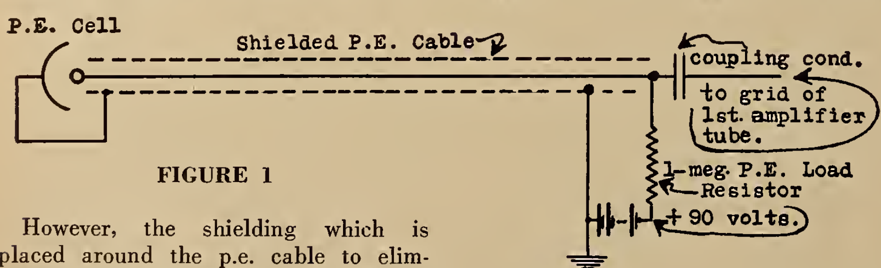

FIGURE 1

However, the shielding which is placed around the p.e. cable to eliminate hum and pickup from various outside sources, acts like a small condenser which is connected directly across the p.e. cell. The higher the frequency, the more easily it is passed through a condenser. Thus, at high frequencies, we have practically a short-circuit of the p.e. cell, resulting in very little of the original light change being registered electrically on the amplifier tube. This is explained in more detail as follows:

Since the resistance of the photocell circuit is very high, it requires only a small condenser to shut out most of the high frequencies. The capacity of an average photocell cable is about .00002 microfarads per foot. The capacity reactance (resistance of a condenser to alternating current) can be figured by the equation:

$$Xc = \frac{1}{2\pi fc}$$

Where Xc is capacity reactance

2π is a constant term, 6.28
f is the frequency in c.p.s.
c is the capacity in farads

Substituting 1000 cycles for the frequency, and $\frac{.00002}{1{,}000{,}000}$ farads for the capacity, we have:

$$Xc = \frac{1}{6.28 \times 1{,}000 \times .00002 \times 10^{-6}} =$$

$$\frac{1}{.0000001257} = \text{approx. } 8{,}000{,}000 \text{ ohms}$$

Thus, one foot of cable has a reactance of 8 megohms at 1000 cycles. The usual length of cable for an amplifier which has separate input tubes would be about 4 feet. If the amplifier is designed such that there is only one input tube for both machines, the cables from both machines are connected together, giving double the length. We will assume that the amplifier has a separate input tube for each machine. Therefore, the reactance of 4 feet of cable would be:

$$\frac{8 \text{ megohms}}{4} = 2 \text{ megohms}$$

Since the p.e. load resistor is 1 megohm, the 2-megohm reactance shunting the p.e. cell will have only a small effect upon the output. However, as the frequency increases above 1000 cycles the shunting reactance lowers. At 5,000 cycles it would be only .4 megohm or 400,000 ohms. Now we see that the .4-megohm reactance of the p.e. cable offers a much lower path of resistance than the load resistor. The effect is that most of the p.e. current at this frequency (5,000 cycles) is shorted to ground, leaving very little

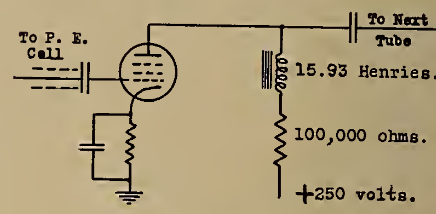

FIGURE 2

to effect a signal on the amplifying tube. Thus the response of the system is very poor above 1000 cycles. If the amplifier has only one input tube, the effect is much worse.

● Corrective Methods

There are several ways of reducing this loss and correcting the response of the system:

1. Reduce the capacity of the p.e. cable as much as possible.

2. Reduce the value of the p.e. lead resistor so that it would be lower than the reactance of the p.e. cable at high frequency (7000 to 9000 cycles).

3. Compensate for the dropping off of the highs, by amplifying them to a greater extent than the lows, so that the net result is again in proper proportion.

The first step is accomplished by using a good grade of cable having considerable insulation between the center wire and the outside shield. The nature of the insulation also has an effect upon capacity. The second step reduces the effect of the cable capacity, but it also reduces the output of the p.e. circuit. Therefore, this step can not be carried too far or the volume will be seriously affected.

After carrying out the aforementioned two steps as far as is practical, the response still is found to be rather poor. The third step can be applied, to bring up the highs. This is done by inserting an inductance in the plate lead of the first amplifier tube (Fig. 2).

The frequency at which the tube will begin to "boost" is approximately the point where the inductive reactance (resistance to a.c. in an inductance coil) is equal to the plate load resistance.

In the circuit shown, the plate load resistance is 100,000 ohms and the frequency at which we wish to begin the boosting is around 1000 cycles. Therefore, the inductive reactance (X_L) should be 100,000 ohms at 1000 cycles. The formula for determining inductive

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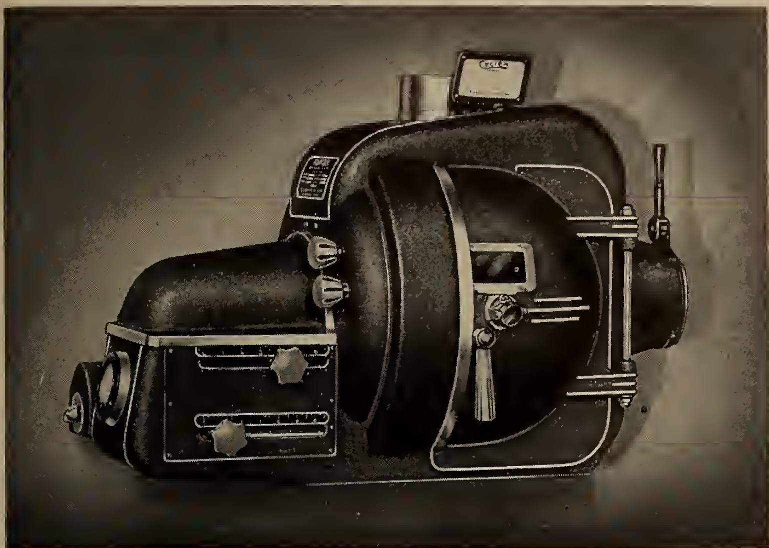

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in henries, it is worth while to note that the capacity reactance is the reciprocal of inductive reactance. If we substitute the values which we know, in equation 3, we will have:

$$L = \frac{100,000}{6.28 \times 1,000} = 15.93 \text{ henries}$$

Thus an inductance of 15.93 henries will have a reactance of 100,000 ohms at 1000 cycles.

The operation of the load resistor in the amplifier tube circuit is similar to that of the load resistor in the p.e. circuit. A voltage change on the grid of the tube causes the plate current to change accordingly. When the plate current increases, the voltage-drop in the load resistor increases, producing a changing voltage which is sent to the next tube. The voltage change at the second tube grid is many times greater than the original voltage change across the p.e. load resistor.

● Frequency Cut-off

When the frequency is below 1000 cycles, the reactance of the inductance coil is negligible, compared with the load resistor. Therefore, the voltage amplification will depend only upon the drop in the resistor. Since the resistor is not affected by frequency, all frequencies up to 1000 cycles will be amplified uniformly.

But above 1000 cycles, the reactance becomes greater than the resistance. Then the voltage-drop in the inductance becomes a factor. As the frequency is increased, the reactance X_L increases. The voltage drop across this reactance is $E = IX_L$ (Ohm's Law for a.c.). Thus the higher frequencies produce a greater voltage change than do the lower frequencies.

To sum up, as the frequency recorded on the sound track increases above 1000 cycles, the "shorting out" effect of the p.e. cable capacity increases, reducing the output. However, in an amplifier corrected for this condition, the frequencies above 1000 cycles are amplified in greater proportion than those below. Thus the output of the system is again a true reproduction of the input and the original quality recorded on the sound track is preserved.

CANADIAN EQUIPMENT POLICY

General Theatre Supply Co., of Toronto, in a circular to exhibitors, advises that although due to differences in the exchange rate between Canada and the U. S., prices on imported theatre equipment have been adjusted upward, the firm has adopted a flexible plan whereby the fixed price of equipment stays static and a surcharge is added computed on the basis of 2 per cent of the exchange rate.

Sound System Servicing Situation

By *JAMES J. FINN*

THE servicing of theatre sound systems would seem to be not a particularly live question at the moment, but the writer received a shock recently when he was accorded an opportunity to view the results of a nationwide survey of theatre sound system servicing made by an equipment manufacturer who is not interested in servicing as such but rather from the point of view of finding additional outlets for his product.

This survey revealed a state of affairs in the servicing field that would not be credited by the uninformed. A quick recapitulation of the type of servicing now offered in the theatre field will serve best to introduce the topic.

There are two major servicing companies in the theatre field, Altec and RCA, both of which are eminently fitted for such work on the scores of manpower, equipment and experience. Next in importance are the servicing groups set up by large theatre chains several years ago, including Loew's, Dallas Interstate, Saenger, Wilby & Kincey, Warners, *etc.* These groups also make a good job of servicing, and they are in constant intimate touch with the latest technical developments. The union servicing groups have pretty much passed out of the picture, although a couple units still continue. These latter outfits, when active, did as good a servicing job as anybody before or since.

This brings us down to the small so-called independent fellow, who may have anywhere from one to ten theatres under contract. In nearly all cases this fellow is the local radio man who dabbles in theatre sound servicing on the side, usually at some ridiculously low figure. This is the fellow who does the worst possible servicing job imaginable, not from choice but because he is unable to assemble the proper tools, too keep abreast of latest developments in recording and reproduction, and has absolutely no training outside of the radio field, particularly in acoustics.

Now, it matters not one whit to the writer which agency is selected to do the servicing. His only interest in this direction is in the matter of *what kind* of service is rendered. Not a few theatres go along without any service whatsoever, apart from general supervision by projectionists, and this is o. k. with the writer. In fact, it would probably be better to have no service at all rather than have some novitate tinkering around with circuits and speakers about which he knows little or nothing.

● Lack Aids, Experience

In the aforementioned survey there appear some of the most ridiculous questions imaginable anent sound pictures posed by these "independent" servicemen. Test loops, frequency runs, and the matter of balancing projector output are a deep, dark mystery to a great majority of these fellows. Their tool complement often does not exceed those few standard items found in the average handyman's kit. Examples of "matched" equipments assembled from as many sources as there are components in the system constitute polygot reproducers that serve no useful purpose and reflect only the ingenuity of the serviceman.

The writer does not mean to imply that no independent serviceman can do a satisfactory theatre job, or that only the large servicing organizations do acceptable work. The latter stub their toes every now and then, and there may be a few independents who fill the bill. By and large, however, it is extremely difficult for these independent fellows to keep abreast of developments in the art and to lay out the money necessary for even an adequate supply of tools.

Whether a theatre utilizes sound system service or not is of little concern to the writer, but he does feel that when a theatre goes for service it should get the very best job available for the money it is paying. Theatres just can't stand the harm done to them by these so-called independent servicemen, and particularly those small houses which must put their best foot forward at all times in order to hold every dollar of patronage.

Of particular interest to the writer, and undoubtedly to the craft in gen-

(*Continued on page* 25)

Manpower Data Wanted

I. P. solicits the aid of all branches of the craft in the collection of copies of laws or local ordinances relating to manpower on projection shifts. Receipt of copies of such ordinances will be very much appreciated by I. P. and will help materially in the campaign for adequate projection room manpower.

Assaying Projector Carbon Performance

By *F. S. HAWKINS*
RESEARCH LABORATORIES OF THE GENERAL ELECTRIC CO., LTD.

The merits and disadvantages of measurement of screen brightness and illumination produced by a carbon arc are critically discussed from the point of view of the carbon maker, who has to assess the quality of the carbons, and it is shown that both of these methods give results which are affected by factors independent of the arc. Thus, screen brightness is affected by changes in the reflection factor of the screen, and also by depreciation of the optical system of the lamp. Screen illumination is also affected by the latter.

A method is described in which these errors can be eliminated or compensated: it consists of the measurement of the luminous flux passing the gate under standard conditions of collection. This is shown to be a quantity proportional to the mean screen illumination, which does not require the use of a screen, and is not affected by changes in the optical system of the lamp, even over a period of many months.

This problem is now engaging the close attention of the Projection Practice Committee of the S.M.P.E., the aims of which will be detailed in these pages next month.

THE testing of carbons and the measurement of screen brightness in a cinema are two different aspects of the same problem which are best treated by somewhat different methods. Before a new carbon can be considered suitable for release it is essential that it should be thoroughly tested in all possible ways, and the tests that are applied fall quite naturally into two groups, *viz.* measurements of physical properties (such as their strength and electrical resistivity) and measurements of the characteristics of the arc and of the carbons when they are being burnt in the arc. Examples of tests of the latter type are the determination of screen brightness and burning rate of the carbon; other similar tests are the assessment of the color of the light, its steadiness and uniformity.

The tests have in every case the twofold object of discovering whether an experimental carbon is up to or above the required standard of quality, and whether this standard is maintained in production. It would be impossible to describe and discuss all of the tests made upon the carbons and the arc within the limits of a single article, and in this case it is proposed to discuss only the methods used for the assessment of the screen illumination given by carbons.

Patrons will see the films in comfort only if the screen brightness has a suitable intensity, and it would seem at first sight that measurements of this quantity would be suitable for assessing the performances of carbons. Such measurements, too, are comparatively straightforward and can be made with standard types of instruments, as many well-known types of photometer are brightness photometers. In addition, portable forms of these instruments have been developed for the measurement of the brightness of artificially lit roads, and have been used in the cinema for screen brightness measurements either from the projection room or from any convenient position in the auditorium.

It was found, however, when making laboratory measurements that there was a gradual change in the values of screen brightness measured, which was in no way connected with a corresponding change in the carbons burnt. It was due to the gradual deterioration of the screen as a result of ageing of its surface. In order to allow for this effect, it was necessary for each determination of the screen brightness to be made up of two measurements, one the screen illumination, and the other a corresponding measurement of the reflection factor of the screen—the combination of the two giving the screen brightness.

Only one of these factors, the screen illumination, is affected by the arc, reflection by the screen being a property of the screen alone. In addition, the latter is a variable factor, dependent upon the state of the surface of the screen; so it was decided that for the purpose of testing carbons it would be best to omit it and measure only the screen illumination.

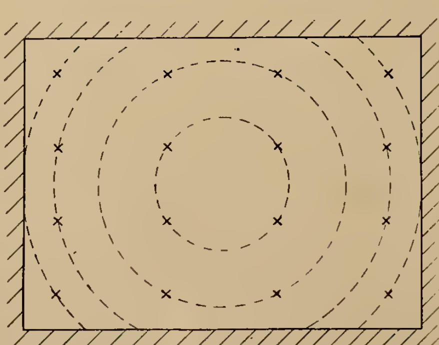

FIGURE 1

Points at which screen illumination is normally measured

● Measuring Screen Light

The method of measuring the screen illumination permits the measurements of the variation of the illumination over the surface of the screen, and also any alterations that may occur in the duration of the test.

The apparatus consists of four rectifier photocells spaced uniformly along a horizontal bar, which is the width of the picture. The bar can be moved up and down, and a switch enables any one of the cells to be connected to a galvanometer, thus giving an arrangement that permits the illumination to be measured at a large number of points on the surface of the screen. In this way, the diversity of the illumination can be ascertained. Usually the illumination is measured at sixteen points over the surface of the screen, twelve points around the edges and four nearer the centre, as shown in Fig. 1. The isolux lines, on which these points are situated, will, if circular in shape, have the positions shown by the dotted circles.

Averaging the screen illumination values obtained by such an arrangement permits of the integrated value of the screen illumination being obtained within an accuracy of 3 per cent or better, for all values of the diversity found in practice. As, however, it is often the case that carbons which are being compared have positive craters of similar dimensions, and so give similar screen diversities, the error arising from the use of the average instead of the integrated value, is, in these circumstances, very small indeed and can be neglected.

A fifth photocell is permanently fixed at the centre of the screen, and is connected to a separate galvanometer, whose readings show any variation that occurs with the passage of time.

The aforementioned method of measuring the screen illumination has been in use for a period of years with satisfactory results. It gives both the mean value of the screen illumination, and the variation of the latter over the surface of the screen, and has the advantage over measurement of screen brightness of not using a screen whose

reflection factor must be frequently checked. It is also readily adaptable to the photo-electric methods of photometry

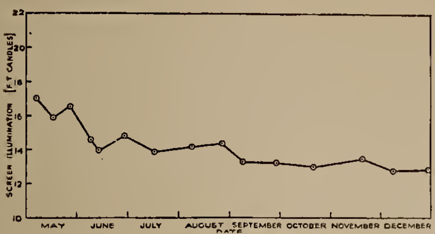

FIGURE 2

Decrease of screen illumination resulting from deterioration of projector optical system

which are so convenient when many hundreds of measurements are required.

The value of measuring the diversity of the screen illumination as well as its average is illustrated in Table A, which gives the results obtained when low-intensity carbons of diameter from 16 mm. to 7 mm. were burnt in a mirror lamp. The diversity is expressed as the ratio of the four corner to the four centre readings, expressed as a percentage (Fig. 1) and for carbons of 16 mm. to 10 mm. diameter it changes only slightly. With a crater diameter of less than 6 mm., which in this case is given by carbons of less than 10 mm. diameter, a flare spot begins to develop in the centre of the screen, as is shown by the rapid fall in the diversity percentage. Clearly, it would be undesirable to use a carbon with a crater of less than 6 mm. diameter in this lamp.

● Optical System Losses

Every projector is fitted with a mirror or condenser the function of which is to collect the light emitted by the arc and concentrate it upon the gate; efficient collection will be obtained with a practical size of mirror or condenser only if it is placed fairly close to the arc. In these circumstances, the action of the heat and fumes to which it is exposed will cause a slow loss in its reflecting or transmitting power, and, as a result, the screen illumination will suffer a slow fall that is scarcely perceptible from day to day, but over a period of months the drop is considerable.

Figure 2 shows the results obtained during a test lasting about 8 months, in which factors other than the depreciation of the optical system were kept constant. It will be seen that during this period the mean screen illumination drifted down by nearly 25 per cent. Each point on the figure represents the average screen illumination of four carbons, and is the mean figure of 64 readings.

There is also another source of variation which is particularly noticeable on some winter days, namely, the scattering of light from the beam by fog or smoke, which may cause a decrease of about 15 per cent of screen illumination even if a short throw of 30 feet is used. Clearly, it is desirable for many purposes, particularly the regular testing of batches of an established brand of carbons, to have a means of preventing or compensating for these variations, so that the test results will not be affected by changes in the lamp but only by changes in the carbons themselves.

● Method of Compensation

As it was found that control of the scattering of the beam and prevention of the deterioration of the optical system was not practicable, methods of compensating for these losses were tried. A suitable method is to adjust the sensitivity of the photometer so as to correct for any change arising from such effects as the deterioration of the mirror; and this can be accomplished in the following way.

The carbons are removed from the lamp, and a light source comparable in size with the positive crater and having a constant light output is put in the focus of the mirror or condenser, *i.e.*, the place normally occupied by the positive crater of the arc; then the light collected by the mirror or condenser is correctly focused on the gate in the usual manner. A measurement of the screen illumination given by this light source is then made. As the light output of the source is constant, changes in the screen illumination can be caused only by alterations for which compensation is required, and this is obtained by a suitable adjustment of the sensitivity of the photometer.

A suitable light source for this purpose is a tungsten filament lamp, run at constant voltage, the lumen output of which is periodically checked.

● Illumination Compensation

Experiments were first directed towards the compensation of screen illumination measurements, correction being obtained by altering the opening of a rotating sector disc, which was used to reduce the intensity of the beam. It was soon found, however, that a source of constant light output comparable in intensity with the arc was required, which was difficult to achieve. The best results were obtained with a low-voltage, high-watage tungsten filament projector lamp in a bulb of special design, but work along these lines was abandoned as an integrator used to measure the amount of flux passing through the gate had proved much more adaptable to methods involving compensation.

TABLE A

Effect of change of crater diameter on diversity percentage

Carbon Dia. Mm.	*Mean Crater Dia. Mm.*	*Diversity per cent.*
16	11.2	80
14	9.4	78
12	8.2	73
10	5.8	70
9	5.2	57
8	4.5	52
7	4.3	47

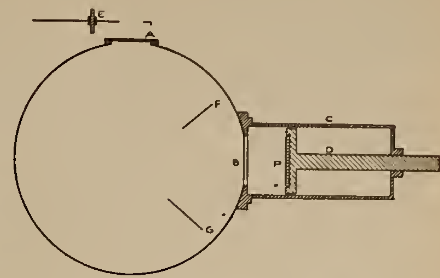

FIGURE 3

Horizontal section of integrator

The mean value of the light passing through the gate was measured with the aid of an integrating sphere equipped with a window the size and shape of the gate of the projector. The light from the arc was passed through this window by means of the collecting mirror or condenser, and the mean value was obtained by the usual method of measuring the brightness of the internal surface of the sphere.

The detailed arrangements are as follows. The sphere, 1 foot in diameter, is equipped with two windows set at right angles to each other (Fig. 3). One of the windows, *A*, was made slightly larger than a projector gate and was carefully masked until the opening left was exactly gate size. The other window, *B*, of 2½ in. diameter, was filled with opal glass. The opal glass also formed one end of a cylindrical metal side tube, *C*, which contained a photocell, *P*, mounted in a holder, *D*. The latter was arranged to move backwards and forwards along the tube, thereby moving the photoelectric cell away from or towards the opal window and so altering its effective sensitivity.

A sector disc, *E*, having a large cut-off, operated in front of the gate window to reduce the flux entering the sphere to an amount convenient for measurement. Screens *F*, *G*, were placed inside the sphere to prevent non-integrated light from reaching the photocell, and the whole of the inside was painted matt white.

When the apparatus is in use, the light from the arc is thrown on to the gate window by the mirror or condenser in the usual manner, the gate window occupying the position normally

taken by the gate in the projector. Much of the light and heat is stopped by the rotating sector disc, which passes only a definite fraction of it into the

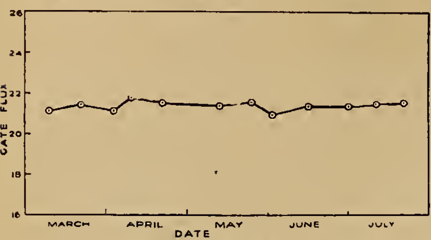

FIGURE 4

Measurements of gate flux, with compensation for deterioration of optical system

sphere, and the light then suffers multiple diffuse reflection on the sphere's internal surface. The brightness of the screen portion of the sphere wall is then proportional to the flux entering the gate window. The photocell will respond to the brightness of the internal surface of the sphere, and so its readings are a measure of the amount of luminous flux passing through the gate.

The photocell was of the rectifier type, selected from a batch and chosen for its small temperature co-efficient and comparative absence of fatigue. Its color response is similar to that of other cells of this type, and comparisons made with a visual photometer have shown that the errors arising from this source are small, less than 3 per cent, provided that the arcs tested all emit light of similar spectral energy distribution.

Such a cell permits the inter-comparison of a group of high- or low-intensity arcs, but if used for comparisons between such arcs, a correction factor must be applied to allow for the marked difference between the color and spectral energy distribution of these two light sources.

● Gate Light Flux

In applying the principle of compensation to these measurements, it is only necessary to correct for the deterioration of the light-collecting system used with the arc, as the beam is no longer projected and so is not reduced in intensity by atmospheric scattering. The integrator itself is particularly adaptable to this end, as the effective sensitivity of the photocell can be easily altered by moving it to or from the opal window. Also, the sector disc reduces the flux that is actually measured to an amount comparable with that given out by a comparatively low-wattage tungsten lamp, and so enables such a lamp to be used as a source of constant light output. The method finally adopted for compensating for changes in the collecting system of the lamp is as follows:

Before measurements are made on the arc, the sector is removed and a 36-watt tungsten lamp is placed with its filament set horizontally in the position normally occupied by the crater of the positive carbon, and is run at a carefully controlled voltage in order to furnish a source of constant light output. An image of the filament is formed at the gate window by adjusting the focusing controls of the arc lamp, and the response of the photocell, measured by a low-resistance galvanometer, is noted. If the optical system has changed, the reading of the galvanometer will differ from the standard reading which represents the normal performance of the lamp, and to compensate for this, the photocell is moved toward or away from the opal window until the standard reading is obtained. The tungsten filament lamp is removed, the sector is replaced, and the apparatus is now ready for measurements of the arc light.

By this means the change in the collecting power of the optical system is corrected by a corresponding, but opposite, change in the effective sensitivity of the photocell unit, and in these circumstances the photocell readings are a measurement of the gate flux under standard collecting conditions. Consequently, they are affected only by changes in the arc and not by changes in the apparatus.

Their independence of depreciation of the apparatus over a long period is illustrated by Fig. 4, which shows the results obtained during a test of some 5 months' duration on carbons of the same size and type burnt under identical conditions. The effectiveness of the compensatory device can be judged by comparing Figs. 4 and 2; the latter shows a fall of some 25 per cent in screen illumination caused by changes in the optical system, whereas when the measured values are independent of such changes there is no steady fall with the passage of time, but only fluctuations about the mean value, not exceeding ±2.5 per cent. As before, each point on the diagram is the average value given by 4 pairs of carbons, and in this case each point is the mean figure of 96 readings.

TABLE B

Measurement of gate flux under standard collecting conditions, using different condensers

New Condenser	*Old Condenser*
21.5	21.0
21.3	20.6
21.4	20.5
21.6	21.3
21.8	21.4
21.5	21.1
21.0	22.3
21.6	21.7
Mean 21.5	21.3

Another test which reveals the effectiveness of the compensation is to take measurements on the same batch of carbons, using two different collecting systems, one of which is new, the other old and deficient as a collector.

The results of such a test, using a condenser lamp, are given in Table B. Of the two condensers used, one was a new one; the other was considerably pitted and transmitted about half the normal amount of light. Even so, by using the compensation device, the mean value of the gate flux under standard collecting conditions, using the old condenser, differs only by 1 per cent from that given by the new lens.

● Comparison of Methods

Two methods have been described for assessing the illuminating power of the arc: one measures the light flux passing through the gate, the other measures the flux reaching the screen, although these two quantities are not the same, comparison tests using the same carbons have shown that there is satisfactory agreement between the results they give.

This is demonstrated by the figures in Table C, which shows the results of such a comparison. Two different arc lamps were used for this test, one a condenser lamp, and the other a mirror lamp with a wider angle of embrace between the mirror and the gate. The projection lens had a focal length of 4¼ in., and an aperture 2 in. in diameter. Insufficient time elapsed during the tests to permit of any appreciable deterioration in the mirror or condenser used.

For the two methods to be equivalent, the ratio of the readings for any one lamp should remain constant, and, as inspection of the figures in the column

(*To foot of Col.* 1, *next page*)

TABLE C

Comparison of the two methods of measuring the illumination given by the arcs

Condenser Lamp			*Mirror Lamp*		
Integrator	*Screen*	*Ratio*	*Integrator*	*Screen*	*Ratio*
21.5	11.1	0.52	17.2	12.8	0.74
19.8	10.3	0.52	17.5	12.6	0.72
19.4	10.3	0.53	17.9	12.9	0.73
22.1	11.7	0.53	18.3	13.3	0.73

"Nitrocellulose is the nightmare of the safety engineer. It ignites easily—even spontaneously—burns rapidly, produces much heat per pound, supplies of itself the chemicals needed for combustion, and, especially when burning in a restricted oxygen, produces lethal gases . . . Film stock held in the beam of a high-intensity arc light will ignite with explosive force in about 1.4 second."

Safekeeping the Picture Industry

By *K. W. KEENE*

UNDERWRITERS' LABORATORIES, INC., SAN FRANCISCO, CALIF.

THE United States of America is the most hazardous nation in the world —potentially. This is merely another way of saying that the U. S. is the most industrialized nation. Unfortunately there is a close tie-in between industrialization and hazards of fire and accident. . . . The motion picture industry is one of the more hazardous industries. The 1937-38 record of the N. F. P. A. on fires of over $50,000 damage shows three for studios and exchanges which total nearly $400,000, and five for theatres which total over $400,000. Actually this record is a very great improvement over the record of ten and more years ago . . .

Back in 1866 the stock fire insurance companies organized and launched the National Board of Fire Underwriters. The National Board today is an educational, engineering, statistical, and public service organization. It publishes and makes available a large amount of material having to do with hazards; some 70 or 80 of their publications being known as the "Recommended Practices" for various industries or processes . . .

Not the least important of the Board's activities, is its actuarial record of fires in the numerous classifications of insurance risks. Such records are of inestimable public benefit, especially with respect to the formation of regulations for controlling hazards.

● 'Laboratories' and N.F.P.A.

By 1894 the nation had become quite industrialized, and among the causes of many fires were faulty design and performance of materials and equipment. Hence, the need arose for a testing laboratory, and the institution that was established, again by the stock fire companies, was Underwriters' Laboratories, Inc. . . . It is a non-profit organization whose function is to apply the scientific viewpoint and principles to the hazards of fire, casualty, and crime; to develop standards of construction and performance; to conduct examinations and tests for manufacturers and others under the appropriate standard and to make known the results therefrom. In short, it is the laboratory of prevention, detection, protection, and all other fronts against fire, accident, and crime.

In 1896 came the National Fire Protection Association: This is the popular organization whose membership or associate membership is open to anyone having an interest in fire prevention.

The purpose of the N. F. P. A. is to promote and improve the methods of fire prevention and protection, and to obtain and circulate information on the subject. To these ends, a staff of engineers surveys cities and the findings, good or bad, are publicized. Also functioning continuously are numerous technical committees. At the present time there are nearly 50 of these committees, and all work toward the development of "Recommended Practices" so that this or that industry or process may be duly safeguarded. In any given committee, the personnel is made up of those best informed about the particular subject.

● Projection Safeguards

Nitrocellulose is the nightmare of the safety engineer. It ignites easily—even spontaneously—burns rapidly, produces much heat per pound, supplies of itself the chemicals needed for combustion and, especially when burning in a restricted supply of oxygen, produces lethal gases.

There are different kinds of nitrocellulose having somewhat different characteristics, but the apparent ignition point may be taken as about 105°C. Film stock held in the beam of a high-intensity arc light will ignite with explosive violence in about ¼ second. A tightly wound reel will continue to support combustion even under water, but this is not to say that the cooling effect of plenty of water on a film fire is not very beneficial in retarding or stopping the spread.

With reference to the products used by the motion picture industry, what are some of the safety requirements that Underwriters' Laboratories applies to them before they leave the factory and before they can be listed or approved?

Projectors, installed in a room which is itself sometimes quite hot, take nitrocellulose film stock and apply a hot beam of light to it. So the first step is to try to guard against ignition from the beam. The automatic shutter which closes down in case of subnormal machine speed is required. Also, on the present-day machines, the placing of the shutter between the head and the lamp has been a decided advantage. This advantage, however, may have been partly or wholly neutralized by the use of higher-intensity lamps.

In dealing with projectors, the position is taken that film ignition may occur within the head due to film breakage or some mechanical or human failure. Thereafter, the most interesting parts of a projector are the upper and lower fire rollers. These are tested to see that a fire in the head will not communicate to the magazines. Twenty-five feet of film is placed within the head, with ends terminating within the magazines. The film is then ignited at the aperture and the doors are closed. The criterion is, of course, whether fire passes the roller into either magazine.

This is a stationary test and admittedly leaves something to be desired by our engineering idealism. However, in consideration of the satisfactory

†J. Soc. Mot. Pict. Eng., XXXIII (Nov. 1939).

PROJECTION CARBONS

(*Continued from preceding page*)

headed "ratio" will show, this is found to be the case. As before, each of the foregoing readings is the mean value of a large number of determinations on four carbons.

Thus, there are two methods of assessing the illuminating power of a cinema arc. One, the determination of the illumination at a number of points on the surface of the screen enables a value to be obtained for the mean screen illumination and its diversity, but is subject to the disadvantage that the measurements are affected by depreciation of the optical system and by scattering of light in the beam. The other, the measurement of the flux passing through the gate under standard collecting conditions, is free from these disadvantages, but does not permit of the measurement of the diversity. The regular use of both of these methods has been found to give a close check on the illumination given by the carbon arc in the motion picture projector.

record of fire roller failures, the practical difficulties of designing rollers that will be effective under all conditions, and the third line of defense which is the vented fireproof booth, the present-day fire roller is probably good enough.

● Other Room Requisites

There are many other requirements of varying importance which are applied to projectors. Magazines are for protection of film. They must be of 22-gage steel or other approved metal; must not depend on solder; must fit a projector or sound-head so that film will not be exposed, and must have tight-fitting doors provided with a positive latch. Perhaps someday it will be desirable to vent projector magazines into one of the existing ventilation systems so that products of decomposition or combustion can not be liberated into the room.

Arc lamps must have housings not lighter than 24 gage which enclose all electrical parts; must have provision for ventilation; must be arranged to retain sparks within the housings; must prevent any possibility of "grounding" the carbons; must have doors hinged and latched; must have a douser to shut off the beam of light; must employ mica or other high-temperature electrical insulating material; must preclude the possibility of "bridging" dielectric spacings with carbon dust; must provide the flexible "motion picture cable" for connecting leads. Motors are investigated, as are other applications of motors, under the Standard for Motor Operated Appliances.

Film-storage cabinets must provide a liberal ratio of vent area to storage capacity; must have an interior space not larger than 10 cubic-feet; must not provide for storage of more than 375 pounds of film per cabinet; must provide individual doors or covers for each compartment which are practically smoke-tight, and must be thermally insulated so as to prevent communication of fire from within one cabinet to others.

Inspection machines must have magazines and fire rollers as effective as those required of the projector. Inspection machines may expose not more than 5 feet of film. Simple rewind machines must fully enclose all film during the rewind process.

Motors and the various units of sound recording and reproducing systems are examined and tested under appropriate standards. The interest in all electrical equipment is to see that its design is such that fire will not start and to see that enclosures and housings protect the contained apparatus from outside damage and also protect persons from shock. Equipment must be capable of being installed in accordance with the rules of the National Electrical Code.

In addition to adequate housings and the electrical grounding thereof, materials of construction, both electrical and mechanical, must possess characteristics suited to the application; combustible materials must be kept to he practical minimum; wireways must be smooth; connections must be tight and workmanship in general good; spacings of uninsulated parts and the dielectric strength of materials must be sufficient to withstand the applied voltages plus a factor of safety; operating temperatures must not exceed the prescribed limits of materials used.

● Downward Loss Trend

These brief capitulations of the salient interests in motion picture apparatus will serve to give some idea of what it is that Underwriters' Laboratories expects of apparatus before it can be listed or approved. Here is one reason why this country is actually a safer place today than it was before the turn of the century—a fact proved by the downward trend of fire losses.

Perhaps some of you heretofore have known of "The Underwriters" as a far-away something or somebody doing things that are remote from your own world and affairs. If so, it will be hoped that these remarks will introduce to you forces for safety in our technological civilization whose influence is and always has been very close to you.

10% Studio Wage Increase Averts General Strike

A threatened strike of all I. A. members in both studios and theatres was averted by the sudden decision of the producers to grant a 10% wage increase to various studio crafts who, following the I. A.'s lead, demanded the increase.

Under the terms of the agreement it was stipulated that the producers be given an opportunity on or about Feb. 15, 1940, to show that continuance of the increase would be economically impossible. The crafts, in turn, agreed to surrender the increase at that time if convinced of the necessity, and also to surrender increases granted to AF of L crafts subsequent to Aug. 15, 1938.

In case of a dispute when the subject is reopened, all parties agreed to submit the controversy to an arbitration board. Each group will select an arbitrator and these two will select a third arbitrator. All have agreed to abide by the decision of this board as final settlement.

Meeting of the signatories to the Studio Basic Pact resulted in a 10% wage increase for members of the I. B. E. W., Teamsters, and Carpenters internationals. Two additional internationals, the plasterers and the laborers, were admitted to the Pact with its closed-shop protection. Musicians asked for no increase. I. A. was not represented at the meeting, feeling that its affairs had all been settled on the Coast previously.

NEW ALTEC CONTRACT ON INCLUSIVE SERVICING

Introduction on a nation-wide basis of a new form of contract relating to motion picture equipment has just been announced by Altec Service Corp. The new contract form covers the furnishing of repairs and replacement parts for projector mechanisms, arc lamps, arc generators, rectifiers, and associated apparatus.

The new form of contract is offered to exhibitors on a nation-wide basis.

Exhibitor Head Scores Film Stars on Radio

FOLLOWING closely on the heels of Paramount's announced inability to restrain Bing Crosby, among others of its stars, from appearing on radio programs is a blast delivered by Ray Branch, head of Michigan Allied Exhibitors, in the form of a letter to trade paper editors. Branch suggests an immediate round-table discussion of the radio-film competition problem, and asserts that an actual "war" is being waged by radio against the motion picture theatre.

Acuteness of the situation was brought home to him, states Branch, when a patron reported the statement by a radio commentator urging his listeners to stay at home and be entertained by screen personalities. Continued Branch:

"Statements like this one cannot go unchallenged for long or we will have the answer to our query as to what happened to our business.

"We had better have some round-table discussion before it is too late to do anything about it, because it is fast growing into a nightly succession of outstanding attractions and is having telling effects on our box-offices. If we must go to war against this thing, let's do it before the enemy gets so powerful that we are licked before we start.

"And in bringing this to your attention let me say in conclusion, all you have to do is to stay at home for one week, and tune in on the leading stations on your radio, and you will probably be able to figure out just why you are in the red, and you will find out that somebody has borrowed your franchise to take your business away from you, and it is not a competitive theatre either."

The magazine *Boxoffice* has compiled the following list of film personalities whose backgrounds are normally associated with the screen—not radio—and who are down for spots of a rather permanent—not guest star—nature on the current season's ether programs:

Don Ameche, Kenny Baker, Jack Benny, Edgar Bergen, Nigel Bruce, Bob Burns, Burns & Allen, Bing Crosby, Cecil B. DeMille, Andy Devine, Nelson Eddy, Judy Garland, Nan Grey, Jean Hersholt, Bob Hope, Walter Huston, Arthur Lake, Dorothy Lamour, Jesse Lasky, Herbert Marshall, Tony Martin, Ona Munson, Conrad Nagel, Gale Page, Joe Penner, Roger Pryor, Basil Rathbone, Edward G. Robinson, Penny Singleton, Virginia Verrill, Donald Woods and Roland Young.

Technicolor Adventures In Cinemaland†

II

By *HERBERT T. KALMUS*

PRESIDENT, TECHNICOLOR MOTION PICTURE CORPORATION

An account of some of the highlights in the history of the development of the business of Technicolor Motion Picture Corp., incidental to which is an account of the development and growth of the various Technicolor processes from a semi-technical point of view but with special reference to practical application in the motion picture industry. This paper won the SMPE Journal Award for the best paper published therein during the year.

PRIOR to 1926 over two and one-half million dollars had been spent, but now I was not calling for money for cameras, printers, imbibition machines and research salaries; it was to go into production. When they asked me what I knew about production, I frankly told them nothing, but at least I could start from scratch without some of the fixed ideas and prejudices concerning color that some of the Hollywood producers seemed to have accumulated.

I wanted to make short subjects, not primarily to make money as a producer, but to prove to the industry that there was nothing mysterious about the operation of Technicolor cameras, that the transition from what the eye saw to what the emulsion recorded was susceptible of reasonable control through understanding, that black-and-white cameramen could easily be trained to light for Technicolor cameras, that talented art directors could readily begin to think in terms of color, that rush prints could be delivered promptly, and generally that the job could be done efficiently and economically, utilizing but not minutely imitating black-and-white experience.

● First 'Short' Series

The first short we produced was a story of the creation of the American flag, an episode involving George Washington and Betsy Ross. George M. Cohan probably never produced anything more certain of applause than when Washington unfurled the first American flag in glowing color. Another subject was the divorce episode of Napoleon and Josephine, photographed in November, 1927, which was booked all over the world as a companion short to Charlie Chaplin's then tremendously successful production, *The Circus.* We made twelve of these two-reelers, an experience which established the fundamentals of our studio service both in the camera and color control departments, and altogether disclosed the answers to a multitude of practical questions which have served us no end since that time.

They were produced economically and yet we were continually praised about them by Metro who distributed them. In my opinion Technicolor would not have survived without the experience of this series of short subjects. Our friends and customers both in Hollywood and New York praised and applauded these short subjects, *but* they were only shorts. Nicholas Schenck advised us to produce a feature production which Metro would distribute.

I had been much impressed with a production called *The Covered Wagon,* a touching love story with the epic quality of slowly and laboriously conquering a continent. Why not have a love story of Vikings with the epic quality of fighting mutiny and storms to conquer an ocean? Jack Cunningham, recently a writer and associate producer at Paramount, wrote *The Covered Wagon,* so we engaged him to write *The Viking.* We spent $325,000 on this production and got our full money's worth of experience in all departments. But also we got our money back. The late Irving Thalberg thought we had a lot of production for that amount of money, and bought it for Metro by reimbursing our cost to us.

● Silence—and Whiskers

There seemed to be two principal troubles with *The Viking,* both of which I suspected but without certainty. First, it came out among the very last silent pictures in 1929; and second, whiskers. Leif Erickson, the Viking hero, true to character, had a long, curling mustache, whereas American audiences prefer their lovers smooth-shaven. At times the whole screen seemed filled with Viking whiskers. But the picture was a good color job and the first to be synchronized with music and sound effect.

But thus far we had only isolated feature productions. The building of color cameras on the scale they exist today, the building of laboratories of sufficient capacity that prints could be made cheaply enough to make color generally available could not be carried on in terms of an occasional picture.

We brought out two-color imbibition prints with silver sound track in 1928. The advantages in respect of focus, cupping, scratching, size of reel and cost of manufacture were immediate. The gelatin on the Technicolor imbibition film is harder than on ordinary black-and-white, and through the years there is substantial evidence that the life of Technicolor imbibition prints is greater than that of ordinary black-and-white.

By early 1929 all the important studios in Hollywood had become thoroughly sound conscious. This was a great help to us in introducing color. Prior to that, studio executives were loath to permit any change whatsoever in their established method of photography and production. But with the adoption of sound, many radical changes became necessary.

Technicolor was always confronted with objections that photographing in color required more light, different costumes, a knowledge of color composition, additional time, and one or the other of these points, plus the added forceful argument that it cost more money, made it difficult for us to get started. In my opinion the turning point came when we ourselves produced the series of short subjects. By entering the field as a producer, by keeping very careful records of our time and money schedules, and by openly discussing with studio executives everything that we were doing as we went along, we dissipated most of the prevailing misinformation.

Meanwhile our quality was improving; our costs were decreasing. Warner and M-G-M were regularly coming out with satisfactory short subjects in Technicolor, and two inserts were highly successful, namely, *Broadway Melody* and *Desert Song.* Paramount had produced a successful feature length picture in Technicolor, *Redskin.* The studios were beginning to be *color* conscious.

But it remained for Warner Bros. and its affiliated company, First National, to take the first step on a *large* scale. Mr. J. L. Warner signed with us for a series of more than twenty features.

The Technicolor mechanical service of providing and maintaining cameras in good working order and of delivering rush prints on time was well established. Two more subtle departments of service, namely helping producers' cameramen to learn how to light and operate to advantage in Technicolor, and consulting and advising in matters of color control, were being demanded. Cooperation under the head of color control was ranging all the way from deciding the details of the color com-

†J. Soc. Mot. Pict. Eng., XXXI (Dec. 1938).

position of sets, choice of materials and costumes, to the broad planning and preparation of a picture by wiring a color score after the manner in which the musical score is written.

As evidence of the increased color-mindedness throughout the industry, Technicolor had contracts for the ten months beginning March, 1929, covering the photography and delivery of prints of the footage equivalent of approximately 17 feature-length productions. This required a doubling of the Hollywood capacity, which was accomplished in August, 1929. For 1930 Technicolor had closed contracts for 36 feature-length productions which would call for some 12,000,000 linear feet of negative to be sensitized, photographed and developed during that year in the Hollywood plant, and a print capacity of approximately 60,000,000 feet.

Rush Impairs Quality

During this boom period of 1929 and 1930, more work was undertaken than could be handled satisfactorily. The producers pressed us to the degree that cameras operated day and night. Laboratory crews worked three eight-hour shifts. Hundreds of new men were hastily trained to do work which properly required years of training. Many pictures were made which I counselled against, and all in the face of the fact that to book a picture in our crowded schedules called for a deposit of $25,000. At one time we had $1,600,000 of such cash payments.

In Warner's *Wax Museum* and Goldwyn's *Whoopee* the Technicolor two-component process may have reached the ultimate that is possible with two components.

By reason of the fact in Technicolor of complete separation of the sound-track technic from the picture technic, the necessity (as in black-and-white procedure) of compromise between the sound and picture quality is avoided and relatively better sound-track should result.

My greatest anxiety at the time was that there might be thrust upon the public productions which would be very crude in color composition and unfaithful in color reproduction. Our own color control department was doing everything possible to consult with and advise directors, authors, art directors, wardrobe heads, paint departments, and others in the studio, and this department was being expanded as fast as practicable. But there was more involved than questions of composition and design. There were the limitations of the process.

As early as May 29, 1929, I reported to our directors: "The fact that we have signed this large volume of business on the basis of our present two-color process has not altered, in my opinion, the fact that the quality of this two-color output is not sufficiently good to meet with universal approval, and hence cannot be regarded as ultimate. I feel confident that the shortcomings of our two-color process will be aided by the fact that they are combined with voice, and particularly by the fact that the work includes so many girl and music type productions. . . . Also, this combination will offer a very considerable novelty angle for a time which is always important in the amusement world. Gradually, however, I believe the public will come to realize that these two-color pictures do not represent an ultimate natural color process. Consequently I feel urgently that our drive to put our process on a three-color basis as soon as possible should not in the least be abated because of our success in getting business on the two-color basis. This three-color work is moving ahead and involves a very considerable research department in Hollywood . . ."

This premature rush to color was doomed to failure if for no other reason because the Technicolor process was then a two-color process. In the last analysis we are creating and selling entertainment. The play is the thing. You cannot make a poor story good by sound, by color, or by any other device or embellishment. But you can make a good story better. Broadway has a terrible struggle each season to find good stories or plays for a dozen successes. Hollywood is trying to find over five hundred. They don't exist. The industry needs all the help it can get, all the showmanship it can summon—it needed sound; it needs color.

But color must be good enough and cheap enough. The old two-component Technicolor was neither — hence it failed, but it was a necessary step to present-day Technicolor.

During the rush to color, Technicolor had not only its own shortcomings to contend with but also a surfeit of poor stories that were to be saved by color, and a monotony of musicals more or less on the same formula. An injustice was no doubt done Technicolor by causing it thus to be identified so largely with musical and period productions. I counselled at the time that producers were no doubt losing an opportunity in not taking advantage of the fact that color can be used to intensify dramatic effect and bring out the best points of personalities, advantages which have been later used with striking effectiveness.

Extensive Research Work

During the years 1929 and 1930 Technicolor appropriated over $3,000,000 for plants, equipment, and research work, which increased its plant capacity from one million to six million feet of two-component prints a month. At the same time that it had been building those plants and training personnel to operate them, it had been filling its orders. Such conditions were not conducive to the highest quality product, even if the orders had been normal.

The fact that this rush was largely forced upon Technicolor by the producers wouldn't help in the slightest degree with the exhibitor or the audience, even if they knew of it. And executives who were glad to try to work it out with us gradually over a period of time, were suddenly confronted with the necessity for drastic curtailment of their own budgets because of a sharp drop in motion picture theatre attendance. At the peak of the rush Technicolor had 1200 men employed with a payroll of approximately $250,000 per month, whereas by the middle of 1931 these had dropped to 230 men and approximately $70,000. In the middle of 1931 picture production in Hollywood was at an extremely low ebb, and the last week in July is said to have been the worst week for theatre receipts in fifteen years.

During 1931 the base price of Technicolor prints was reduced from 8¾ to 7 cents per foot.

But Technicolor had persisted in its research and development work so that by May, 1932, it had completed the building of its first three-component camera and had one unit of its plant equipped to handle a moderate amount of three-color printing. The difference between this three-component process and the previous two-component process was truly extraordinary. Not only was the accuracy of tone and color reproduction greatly improved, but definition was markedly better.

Disney Color Cartoons

However, we could not offer the three-component product to one customer without offering it to all, which required many more cameras, and the conversion of much of our plant. To allow time for this and to prove the process beyond any doubt, we sought first to try it out in the cartoon field. But no cartoonist would have it. We were told cartoons were good enough in black and white, and that of all departments of production, cartoons could least afford the added expense.

Finally Walt Disney tried it as an

Odoriferous Films

(*Not Hollywood product, either*)

A fragrant film, producing 4,000 different smells which are distributed through what are called "smell aerials," was shown for the first time in Berne, Switzerland, according to the N. Y. *Herald Tribune.*

If, for instance, a bunch of roses is shown on the screen the perfume of fresh roses begins to fill the theatre. The odor changes automatically according to what is being shown on the screen. The device was invented by two Swiss engineers.

[Ed.'s Note: Foregoing is interesting but positively not new. One William Featherstone was granted a U. S. patent on same scheme about ten years ago. Anyhow, idea palpably has too many disagreeable potentialities.]

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experiment on one of his "Silly Symphonies." This first attempt was the delightful *Flowers and Trees,* following which Disney contracted for a series. For Christmas 1932 came *Santa's Work Shop,* the following Easter, *Funny Bunnies;* in May, 1933, came *Three Little Pigs,* which made screen history, and in March, 1934, *Big Bad Wolf.*

I needn't relate the story of Disney's extraordinary success with Technicolor. The "Silly Symphonies" in Technicolor surpassed the "Mickey Mouses" in black and white, and then both Mickies and Sillies adopted Technicolor.

Both the Disney Co. and Technicolor were rather undersize at birth and in recent years both have grown rapidly in importance. A frequent conversation has been as to which helped the other most. Much like the conversation between two Irishmen after a considerable session at the bar: "Yer know, Clancy, when I was born I weighed only five pounds." "Yer did, and did yer live?" "Did I live? Yer ought to see me now."

What Technicolor needed was someone to prove for regular productions, whether short subjects or features, what Disney had proved for cartoons. But the producers asked: "How much more will it cost to produce a feature in three-component Technicolor than in black and white?"

This question is always with us and it seems to me the answer must be divided into two parts; the added cost of prints, negative raw stock, rushes, and lighting can be numerically calculated and requires little discussion. But then there are the less tangible elements about which there is much discussion. I have said to producers and directors on many occasions: "You have all seen Disney's *Funny Bunnies;* you remember the huge rainbow circling across the screen to the ground and you remember the *Funny Bunnies* drawing the color of the rainbow into their paint pails and splashing the Easter eggs. You all admit that it was marvelous entertainment. Now I will ask you how much more did it cost Mr. Disney to produce that entertainment in color than it would have in black-and-white?" The answer is, of course, that it could not be done at any cost in black-and-white, and I think that points to the general answer. A similar analogy can be drawn with respect to some part of almost any recent Technicolor feature.

If a script has been conceived, planned, and written for black-and-white, it should not be done at all in color. The story should be chosen and the scenario written with color in mind from the start, so that by its use effects are obtained, moods created, beauty and personalities emphasized, and the drama enhanced. Color should flow from sequence to sequence, supporting and giving impulse to the drama, becoming an integral part of it, and not something super-added. The production cost question should be: what is the additional cost for color per unit of entertainment and not per foot of negative. The answer is that it needn't necessarily cost any more.

● All-Color Features

In 1932 we marked our base print price down from 7 cents to 5½ cents a foot. Early in 1933 a contract was signed between Technicolor and Pioneer Pictures, Inc., which provided for the production of eight pictures, super-feature in character and especially featuring color. There were some conditional clauses, among others a provision for extensive preliminary tests.

Certain doubts remained in the minds of the producers as to the performance of our three-component process under certain conditions. Would the process reproduce the various shades

(*Continued on page 23*)

Seek Projectionist Aid on SMPE Power Survey

PROJECTIONIST cooperation is solicited by the Projection Practice Committee of the S.M.P.E. in the matter of a national theatre power survey which a sub-committee is now conducting. To obtain the necessary information a data sheet is now being distributed by various cooperating service organizations and supply dealers.

In many instances the information sought is available only through the projectionist, who, being the only technically-minded person in a theatre, is in a position to assist materially in the work. In fact the success of the survey is dependent in large measure upon the help extended by projectionists. In collecting the data care should be taken to clean all equipment nameplates to the end that no major errors be made.

Projectionists may utilize the accompanying illustration as a form for these data, or additional sheets may be had upon application either to I. P. or direct to Society headquarters at the Hotel Pennsylvania, N. Y. City. Completed forms may be returned to either of these agencies.

Name of Theatre ________________ Location ______________________________

1. Seating Capacity __________
2. Number of hours operated weekly ________
   a. Number of evenings in operation weekly ________
   b. Number of daytimes in operation weekly ________

PROJECTION

3. Specify device used for current source:
   a. M.G. set __________ H.P. ________ Generator Voltage ________
   b. Rectifier type ____________________ Amperes Capacity ________
   c. D.C. (from Power Co.) using rheostats ____________
   d. A.C. transformer ____________
4. Which of above is emergency source for arc current? ____________
5. Amperes at arc ____________
6. Carbon trim: Positive ____________ mm Negative ____________ mm. or inches
7. Power source:
   a. Voltage AC __________ Phase __________ Cycles __________
   b. Voltage DC __________ from Power Company.
8. Width of picture ______________________ ft.
9. Distance from screen to row of seats farthest from screen ____________ ft.

GENERAL

10. Lighting service:
    Voltage ________ phase ________ cycles ________ or DC ________
11. a. Are auditorium wall and ceiling surfaces kept very dark during screen performance? ____________
    b. Do auditorium wall and ceiling surfaces appear illuminated during screen performance? ____________
12. Check type air conditioning:
    a. Refrigeration - Freon ________ CO2 ________ Steam Jet ________
    b. Refrigeration plus well water ____________
    c. Well water only ____________
    d. Ice box ____________
    e. Large supply fan only, without refrigeration ____________
    f. Exhaust fan only without refrigeration ____________
    g. Combination supply fan and exhaust fan without refrigeration ________
13. State total H.P. of fan motors, pumps, pump motors and compressors ________ H.P.
14. Following from electric bills for each meter:
    a. 1 summer month-Demand ________ K.W. K.W. Hrs. ________ $ ________ Cost
    ________ ________ $ ________
    ________ ________ $ ________
    b. 1 winter month-Demand ________ K.W. K.W. Hrs. ________ $ ________ Cost
    ________ ________ $ ________
    ________ ________ $ ________

Data compiled by ____________________

Date ____________________

The Ounce of Prevention

By *KENDALL EMERSON, M.D.*

MANAGING DIRECTOR, NATIONAL TUBERCULOSIS ASSOCIATION

Again it is our pleasure to open our editorial and advertising columns to the National Tuberculosis Association as an aid in its fight against tuberculosis. The efforts of this organization have contributed handsomely to the better health of all mankind, and to no particular group in greater measure than to the projectionist craft. Generous purchases of Xmas Seals will assist in the war of extermination against this dreaded white plague.—*Editor.*

WHAT are the simple, basic facts about tuberculosis that all people must know to protect themselves, and especially their children, from its hidden menace? Among such facts the following three are of prime significance:

1. Tuberculosis is caused by a germ and is, therefore, an infectious disease.
2. You must keep people with infectious disease away from other people.
3. People recover from any disease more quickly if it is discovered early and given proper treatment.

In the case of tuberculosis there is no drug, serum or vaccine which has any noticeable curative or preventive value. This complicates our program, but it does not render those objectives impossible. We have worked out a system by which they can be attained provided the doctors, the nurses and the public health officials can receive adequate cooperation from the public at large.

Tuberculosis is caused by a well known germ and is therefore "catching" or infectious, exactly as are diptheria, scarlet fever, measles and smallpox. It is not hereditary, as is sometimes supposed, although it may be that a *family susceptibility* may be handed down. At all events if there has been a good deal of tuberculosis among your ancestors or if it exists in your immediate family, it is well for you to exercise unusual precautions and have frequent check-ups to assure yourself of freedom from active infection.

We will not have tuberculosis if no germs of the disease ever get into our bodies. This can only be avoided by keeping well away from those who have the disease. The surest way to bring this about is by exactly the process we employ in other infectious diseases, isolation of the patient in a hospital where contact with friends and neighbors is avoided and where his cure is most likely to be assured.

● Wide Gains Scored

This principle of isolation was early recognized as the basis of a tuberculosis control program. When the National Tuberculosis Association was formed in 1904 for the study and prevention of tuberculosis there were about six thousand beds for the care of tuberculous cases in the country. There were nearly two hundred thousand deaths annually. Today there are 100,000 beds for the tuberculous and last year less than 70,000 deaths. Despite this increase in beds we still feel the number is too low. At least two beds per each annual death are needed and their distribution must be greatly improved over the situation existing at present because in some localities there are no beds at all.

But isolation of the discovered case is not enough. By detecting a person with tuberculosis in its very early stages and isolating him in a hospital where he will receive expert care we give him practically an 80% chance for satisfactory recovery. The case discovered and hospitalized late has little better than a 20% or 25% chance of returning to approximately normal life. Again we must remember, too, the lurking danger of infecting others that an undiscovered case presents.

The fly in the oinment of tuberculosis control is the peculiar behavior of the disease when once it has established itself in a victim's lungs. In the case of most infectious diseases one becomes visibly ill in a very short period of time. He is put to bed, perhaps hospitalized, and others wisely avoid contact with him during the time that the disease is contagious.

Not so with tuberculosis. To be sure, it may occur as an acute pneumonia, but such cases are rare in comparison with those of slow onset. Weeks or months may pass during which no symptoms are present, yet all the time the germs are digging in and may have begun to cause destruction of the lung, at which time tubercle bacilli appear in a patient's sputum and infection of others may easily occur.

Widespread Cooperation Needed

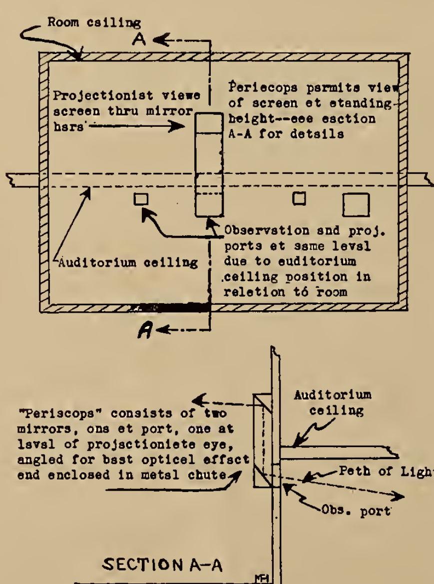
Knowledge of these three facts—that tuberculosis is an infectious disease; that you must isolate infectious diseases; that all diseases are less serious if discovered and treated early—is the common property of all intelligent people. It is the spread of this knowledge among all classes of the population that has enabled the public health service, the doctors and the sanatoria to cut down the death rate from tuberculosis progressively over the past half century. One of the most difficult hurdles in the fight has been jumped. Today, instead of a small number of professionally trained people working alone, the whole body of citizens is becoming aroused. More and more they are participating in the fight. When we get a genuinely united front against our diminuitive, but most persistent enemy, his fate is sealed.

Never before has the opportunity been placed in the hands of man to rid himself of a plague which has claimed the lives of millions. If we do not strike now the opportunity may pass. This is not an appeal to experts. They are already on the alert and their devotion will not flag. It is a direct appeal to the people of this country to see the job through. The verdict in the case of man against tuberculosis is in the hands of the public.

Buy Xmas Seals

Novel 'Periscope' Setup by Altec Permits Clear Screen View Through Ports only 30 Inches off Floor

STRUCTURAL peculiarities make for some strange setups for motion picture projection, but none is stranger



Projection Periscope Setup

than that existing in the Masonic Theatre in New Bern, N. C. With the exception of three years during the Civil War, this theatre has been in continuous operation since 1812, according to its manager, O. A. Kafer, and the architecture, while some pumpkins at the time, leaves something to be desired as a motion picture theatre in 1939.

The theatre auditorium is part of the old Masonic Hall and rooms, the building having been erected about the year 1800. Present Masonic rooms are above the theatre, and their retention necessitated building the projection room on the outside of the structure. The observation port holes are only 30 inches above the floor, and heretofore the projectionists have had to bend away over in order to view the screen.

This procedure seemed like a lot of unnecessary trouble to M. F. Harrod, Altec service inspector, and he proceeded to do something about it. He designed a sort of periscope, consisting of a series of mirrors (see accompanying drawing) which permits a full

Masonic Theatre, New Bern, N. C.

view of the screen at standing height.

Naturally there is a slight distortion in the view at the periscope window, but the results are surprisingly satisfactory, and certainly the setup is vastly more efficient all around than under former conditions. For close focussing of the picture, etc., the projectionist looks through the remaining uncovered port with opera glasses.

Movies' Current Decline Is Charted by Editor Kann

NOTE: *The appended editorial by Maurice ('Red') Kann appeared in* Boxoffice *for Oct. 21. Its shrewd analysis of current conditions in the motion picture industry merits the attention of everybody in the industry, and particularly of the Labor group.*—ED.

AN OHIO exhibitor asks these questions: "Would like you to editorialize on 'Has the Movie Business Hit the Peak?' '1.—Is it on the decline?' '2.—Is public interest in movies diminishing so that grosses will never again hit their former stride?'

"3.—Is the publc tired of the old faces and same old stories re-made and rehashed?" "4.—Are we in the same period of public apathy as preceded sound pictures? I, personally, think so. What do you think?"

There's a modest series of brain twisters, but we'll take the death-defying leap . . .

Reasons for Current Decline

1.—The business is in a current decline, as everyone realizes. And for a combination of causes. Some, the definite fault of the industry. Others, beyond its control. The faults leading into the celluloid household . . . include (a) production of too many pictures which, in turn, spawns too many average or bad ones; (b) a division of production brainpower occasioned by the requirements of double features and, thus, a split in the maximum effectiveness of that power; (c) slavishness to the so-called success formula which nurtures the carbon copy system that Hollywood has relentlessly pursued for years and results in a market glutted with too much of the same merchandise; (d) mobilization of real attractions for simultaneous release in well-established theatre periods, such as Labor Day and New Year's, with long stretches of entertainment drought in between . . .

Outside factors include an unsettled general condition domestically, induced by a precarious situation abroad; opposition by

big business to the New Deal which results in frozen capital, paints the unemployment curve blacker and brings about shrunken audiences for pictures.

Product Quality Factor

2.—Public interest in films rises, falls or remains static in direct ratio to the quality of the entertainment offered. There is no reason for anyone to calculate films are indispensable to a degree which automatically guarantees a prosperous industry. Going to the movies may be a habit. We believe it is and that it will continue. But the significant gauge by which the situation must be calibrated is will they go frequently enough if the studios do not furnish them with a sustained line of attractions they want to see?

To harbor the idea, on the other hand, that grosses will never again attain their one-time peak is to dabble around in unsatisfactory and unpredictable futures. No one can answer such a question conclusively, for this business is too sensitive and too volatile to remain permanently anchored to a given set of conditions.

Old Faces, Old Stories

3.—If the public is not tired of "the old faces and same old stories re-made and re-hashed," they ought to be by this time. Both equations have been played to death. More particularly does this apply to story re-hashes, but the difficulty there flows to the answer to our first question. It is a herculean, as well as impossible, job to make them all click when a single studio is committed to as many as 40 to 60 features each twelve months.

The old face, and its complement, the new face, of course, always has been a baffling problem for Hollywood to solve. The indications . . . are that the effort at developing fresh personalities is currently a trifle more serious than usually is the case . . . It is as essential a task as any confronting the studios. This time, perhaps, it will succeed.

4.—Public apathy toward films, undoubtedly, exists, but it is this opinion the drift has some distance to traverse before it accumulates to the degree prevailing before sound came in. Every time apathy seems to gain, the good luck star under which this business proceeds twinkles brightly again in the guise of unusual attractions which save the day.

The future? It is up to the men who make the product and, while this assuredly is the easiest way to toss off a perplexing question, the obviousness of the approach cannot belie its essential truth.

SLASH TELEVISION SET PRICE

Prices for television receivers will be generally slashed by at least one-third in the near future and wholesale prices will be cut even further to permit a wider margin of profit for dealers. The move follows a successful test in upper N. Y. State where sales increased measurably after the reductions.

Radio officials have been openly disappointed at the failure of the dealers to place the sets on the market. Dealers, on the other hand, took the position that it was considerably easier to market $600 worth of inexpensive radio sets than one television receiver, and that the returns were greater. As a result, only about 1,000 sets have been placed in the metropolitan N. Y. area.

Whitehead Sues for $100,000 from Actor Unions' Execs.

Libel suit for $100,000 damages has been filed in the N. Y. Supreme Court by Ralph Whitehead against Edward Arnold, Frank Gillmore, Kenneth Thom-

son, Paul Dullzell, Emily Holt, Florence Marston, Paul Turner, Henry Jaffee, and Edward Harrison. Complaint states that on Aug. 18 Harrison was authorized by the defendants to publish a statement made by them as a committee for the AAAA in U. S. newspapers, and that he did so.

The statement allegedly depicted Whitehead as being dishonest, stating that he, among other things, had misapplied AFA funds and denied relief to needy actors.

New Conrac Register Counts Picture Theatre Patrons

Conrac, Inc. has been formed to manufacture an electrical device for the counting of patrons entering a theatre. L. W. Conrow and G. L. Carrington (who also head Altec Service Corp.) will be president and vice president of the new corporation, and Harry M. Bessey, secretary-treasurer. These officials are members of the Board of Directors, together with Fred G. Adams, Louis S. Allen, P. C. Kemp and Gilbert L. Kerr.

Conrac, Inc., will manufacture the Conrac Attendance Register, a device by which a theatre entrant passes through two or more pencil beams of projected light. Unusual feature of the new register: while it counts persons entering the door, it does not count persons leaving through the same door. All models provide for keeping a locked and sealed record.

CANADIAN FILM STATISTICS

Canadian Government has issued the following condensed summary of theatre business as of Dec. 31, 1938. The itemized facts are:

Number of theatres, 1,133; total receipts for 1938, $33,625,052; average receipts per theatre, $29,687; total admissions for year, 137,976,052; average number of admissions per theatre, 121,779.

Population of Canada, 11,199,000; per capita expenditure for shows in 1936, $3.02; theatres per 10,000 population, 1.0; total seating capacity of all theatres, 640,366; seats per 1,000 population, 57; total number of theatre employes, 7,248; total salaries and wages for all theatres, $5,666,049; average salary per employed person, $782.

Number of independent theatres, 566; number of two-unit theatre groups, 57; number of three-unit theatre groups, 14; number of circuit theatre groups (4 units and over), 24.

Theatres showing professional vaudeville part-time, 99; theatres showing professional stage shows part-time, 55.

RUNNING TRUE TO FORM

Official investigations into conditions at the Empire Theatre, leading second-run house in the downtown section of Providence, R. I., where a panic resulting from an erroneous shout of "fire" injured 26 persons, one critically.

The panic started when a fight occurred among patrons on the first balcony. A large number of children in the second balcony, mistaking the shouts of "fight" for "fire," stampeded the balcony entrance, causing a jam.

Panic at the Colonial Theatre, Detroit, resulted in back injuries to one patron and undetermined injuries to others. Cause of the panic was a cry of "fire," when someone discovered smoke in the auditorium, coming from some paper ignited in the men's washroom.

Actual damage was practically nil from the "fire," but several persons were injured when patrons jammed the aisles and exits in their rush.

Lend a hand to those whose work has benefitted greatly so many members of the craft: buy as many Xmas Seals as you possibly can. These little seals, sponsored by the National Tuberculosis Association, are slowly but surely overcoming the dreaded white plague.

TECHNICOLOR ADVENTURES IN CINEMALAND

(*Continued from page 19*)

of green in woodland and jungle? For one story they were considering a lead with very dark coloring and black hair. Would she photograph satisfactorily against light backgrounds? For another story they thought of placing a decided blonde in the leading part; how would she photograph against various backgrounds? What about make-up? What about the visibility of extremely small figures in the distance? An exhaustive set of tests were made, with satisfactory results.

Then began the hunt for the first story to be produced. At one time Mr. J. H. Whitney told me they had given consideration to no less than two hundred stories. While Mr. Whitney was searching, Pioneer Pictures made a very practical and complete test of the process by producing the picture *La Cucaracha*. This short subject met with tremendous success.

La Cucaracha, together with "Silly Symphonies," caused a tremendous interest in three-component Technicolor. The industry was now waiting to see what the first Whitney feature production would be like. Meantime Technicolor business was improving. Positive film shipments for the first six months

of 1933 were double what they were for the first six months of 1932. Appropriation was made to increase the number of cameras under construction from three to seven.

The first test of the three-component process on a very large set was for Twentieth Century Fox on the closing sequence of *The House of Rothschild.* Since *Whoopee* in 1930 Mr. Goldwyn and I had talked regularly each year about another picture in Technicolor, so that on one occasion Eddie Cantor asked me if I were coming for my annual ritual. This time it was the closing sequence in his Cantor picture, *Kid Millions,* which was another important early three-component insert.

Pioneer Pictures finally settled on *Becky Sharp* as their first production of the series. *Becky* was a champion for hard luck. The original director, Lowell Sherman, was taken ill and died during the period of photographing. He was succeeded by Reuben Mamoulian. Unusual difficulty was encountered in the sound recording so that Mr. Whitney found himself in the ironically anomalous position of having produced the first three-component Technicolor feature, of having surmounted all the hazards of color, yet being in difficulty with an aspect of the work which he had naturally taken for granted.

During the 1935-36 season we were manufacturing in the neighborhood of 2¾ million feet of prints a month, which included a larger volume of Warner Bros. short subjects than ever before and about 40% of all Metro-Goldwyn-Mayer short subjects.

● British Affiliate Set

A very interesting and important adventure in the history of Technicolor development was the organization of a British affiliate, Technicolor, Ltd. In 1936 the British laboratory was built at West Drayton, just outside of London, where it is now regularly operating to service British-made productions and prints of American-made productions for distribution in the United Kingdom. Generally speaking, these pictures have been extraordinarily well received, some of them having broken attendance records in many parts of the world.

Thus Technicolor has met the second great rush into color with steadily improving quality of its product and a broadening range of service. It is the purpose of Technicolor, during the time that prints of any picture are being manufactured in its plant, to hold the laboratory open for and at the disposal of the customer as if it were his own. His representative may inspect each of his prints and any changes suggested will be undertaken if practicable. To do this he simply moves into the inspection room where each print before shipment is compared by simultaneous projection with a standard print approved by the customer for the purpose.

William Wellman who has directed more three-component Technicolor pictures than any other individual, all of them successes, namely, *A Star Is Born, Nothing Sacred,* and *Men with Wings,* has said repeatedly of Technicolor photography that he takes it in his stride, at substantially the same number of setups per day as black and white. It is noteworthy that most of the camera work is now done by cameramen in the direct employ of the studios.

● Recent Color Developments

About a year ago Technicolor established a department to contact exhibitors directly. Its representatives travel over the country to call upon exchange managers, theatre managers, and projectionists. The purpose has been to study projection and screen conditions at the theatre; to advise how to get the best results with Technicolor prints, to listen to complaints and establish good will, and particularly to obtain projectionist, manager, and audience reactions to productions in Technicolor.

The results have been most gratifying: we have found that the public reaction to Technicolor pictures is extremely favorable and that exhibitors throughout the country are realizing more and more that Technicolor has great box-office value.

Our experiences were marvelously interesting; it was great fun; we couldn't let anybody down, neither customers, employees, stockholders, nor directors. But there was something else too; there was always something just ahead, a plan for tomorrow, something exciting to be finished—yes, and something more to be finished after that; and I am willing to predict that it won't be finished for many years yet.

The type of film which will be standard for natural color pictures ten years hence may not yet have emerged. I predict that within two years Technicolor will have done away with special cameras and be regularly employing single strips of negative through any standard motion picture camera, and that within two months for special purposes, and within six months for more general purposes, it will be offering to its customers a negative for use in its present cameras with from three to four times the speed of its present negative.

That's why we cling so tenaciously; there's always something ahead; there always will be; our pride is enlisted; it's our job.

Discussion:

MR. CRABTREE: I have been wondering whether the usual methods of inserting backgrounds are being used with Technicolor. Were there very many background shots in *Men with Wings?*

DR. KALMUS: We do projection background work regularly.

MR. CRABTREE: Is it as flexible as with black-and-white?

DR. KALMUS: Not quite, but sufficiently flexible to be very practicable.

MR. WOLF: I understand Technicolor will be available in a single film for use in

standard cameras. Will the processing be difficult or will it be as simple as with black-and-white?

Dr. Kalmus: That is geeting into a realm I am avoiding for the present. However, I think it will be some time before the processing will be as simple as black-and-white, if ever. The program as we have it outlined will be simple and practicable as compared with the programs we have been through before.

Mr. Kellogg: When you have a two-color system, do you leave some silver in the film in order to get some black in addition to what you get from the dyes?

Dr. Kalmus: The two-component system was strictly two-component. The present system is really four-component—the three components ordinarily thought of as the color components, and black.

Mr. Thomas: Have you obtained any data of value, from the projection standpoint, from the questionnaires sent out with the prints of *Goldwyn Follies?*

Color-Film Projection Data

Mr. Rackett: We have received valuable information from the projectionists' comments on the cards sent to theatres in advance of the showing of Technicolor pictures.

The comments may be divided into two classes: first, those referring to the physical condition of the film, which have occasioned our making minor changes in the visibility of instruction titles and changeover cue marks; the second, relating to the density and color values of prints, which are a little more difficult to classify as they have to be interpreted in connection with data from our field division relating to projection equipment.

Most theatres are equipped with high-intensity arcs which produce a screen image that is slightly bluish. Technicolor prints are balanced to yield a neutral image on such a screen.

Small projection units equipped with Mazda light produce a screen image that is slightly orange. When a print balanced for a high-intensity arc is projected by a Mazda light the screen result will be slightly orange.

When we are establishing the density and color balance of a feature picture, we make a series of prints and usually arrange to view these with the producer of the picture in a number of first-run theatres, as far as time permits. We then compare a number of prints in a room where we can project simultaneously on matched screens as many as six prints of the same reel. We get a comparison of such fineness that we have not been able to find quantitative methods of measuring the differences.

All the data, including the important and welcome comments of the projectionists on the print comment cards attached to the print suggestion booklets, are very helpful in establishing the final results.

Mr. Griffin: How quickly is the rush print available in the three-component process after the negatives leave the camera?

Dr. Kalmus: Regular twenty-four hour service.

SOUND SERVICING DATA

(*Continued from page* 11)

eral, is a list of the tools and instruments available to the individual field representative of a large servicing group. Such a list has been supplied to I. P. by Altec Service Corp., which points out that many of these servicing aids are exclusive with Altec and of their own design. The utter impossibility of any independent being unable to assemble such servicing aids is apparent from a glance at the appended list:

1. Emergency amplifier. High gain, high quality portable amplifier with self-contained changeover, fader, pec power supply, adjustable equalization and variable output impedance. Designed to replace all, or any part of any sound system from pec to stage horns in case of emergency breakdown.

2. Flutter bridge. For direct measurement of flutter. Consists of a sharply resonant bridge circuit, adjustable to balance out the signal from a special constant frequency film and to measure any remaining spurious flutter modulation introduced by the sound reproducer itself.

3. Audio frequency oscillator. Provides a signal of constant controllable level at any desired frequency in the audio range. Invaluable for tracing transient troubles and for testing components at different frequencies and tracing resonant vibrations in horns and auditorium furnishings.

4. Strobolamp. For checking and adjusting kinetic scanners. Essentially an accurately timed flashing light source for measuring slip and pick-up times, the two main factors governing "wow".

5. Cathode ray oscillograph. An instrument which graphically traces the output wave-form to permit visual analysis of noise, harmonics and other disturbances which may be introduced into a sound system.

6. Wheastone bridge. For precise resistance measurements which are impossible with an ordinary ohmmeter. Measures from .001 up to 9,999,000 ohms.

7. Recording voltmeter. For making a continuous record of power supply voltage fluctuations over a period of time. Often essential in determining whether reported troubles are related to power supply.

8. Calibrated toe-recorded multi-frequency test film. Recording of a number of frequencies selected to cover the vital spots in the sound spectrum, each frequency individually calibrated relative to a flat characteristic and relative to zero level. Essential for determining the true gain and response characteristic of the entire electrical sound system *plus* the optical system and photoelectric cell.

9. Steel film standard. Accurately cut film of tempered steel used to make correct alignment of the film path through the sound reproducer, proper spacing of guide roller flanges and for measuring film shrinkage. Corrects the foregoing factors as contributors to noise and flutter troubles.

10. Buzz track test film. For effecting optimum adjustment of film guide rollers, light gates and aperture plates as a prevention of sprocket hole and frame line noises.

11. Short transmission test frequency film. A two-frequency film for quick transmission tests.

12. Calibrated flutter film. A carefully recorded 3000-cycle film of low flutter content, calibrated to serve as a standard in making quantitative flutter measurements of sound reproducer operation.

13. Special 8000-cycle loop. For adjusting optical systems for zero scanning azimuth and perfect focus.

14. Academy of M.P. Arts & Sciences high quality sound test reel. Current product of all major producers for final check and adjustment of sound reproduction.

15. Academy scanning beam test film. Film having 17-position sound track for checking the centering and uniformity of scanning beam illumination over the length of the scanning slit.

16. Calibrated multi-frequency lateral test record. For making frequency response checks of lateral disc reproducers.

17. Vacuum tube test set. For routine checking of vacuum tubes under operating conditions to anticipate and prevent impending failure.

18. Foot-candle illuminometer. For checking and adjusting uniformity of screen illumination from portable sound

reproducers having self-contained light sources.

19. Combination power level indicator and a.c. voltmeter. Scales: 0-1.5-6 15-60-150-1200 volts, and from —18 to +56 db. For noise level measurements and routine checking and trouble shooting. Used for transmission and power output measurements.

20. Combination ohmmeter and d.c. sensitive voltammeter. For routine testing and trouble shooting.

21. A.C.-D.C. electro-dynamometer. For precision voltage measurements up to 750 volts where accuracy of the order of one part in 400 is required.

22. 0-300 a.c. voltmeter. For special voltage applications where high accuracy is required.

23. Micrometer deflection indicator. For measuring cam action of sound sprocket shafts in tracking down causes of flutter.

24. Biddle megger. For testing the insulation resistance of cables, oil-soaked wiring, etc., where intermittent fading, loss of sound and noise disturbances are encountered.

25. W.E. telephone headset. For making point-to-point checks for sound transmission when trouble shooting.

26. Socket selector outfit. For swift measurement under operation of voltages and currents in vacuum tube circuits.

27. Lens adjusting tool. Specially designed tool for fine adjustment of the optical system to provide optimum high frequency reproduction.

28. Aperture plate gauge. For the accurate alignment of aperture plates when replacements are made.

29. Lens cleaning tool. Designed to facilitate the cleaning, without damage, of highly polished lens surfaces of the optical system which are hard to get at with ordinary means.

30. W.E. gram gauge. For the accurate measurement of spring tension of the various shoes, light gates, rollers, etc. of the sound reproducer and for the proper adjustment of the takeup drive for uniform takeup.

31. Kinetic scanner drum gauge. For critical alignment of kinetic scanners relative to the free film path and for adjusting associated pressure rollers to assure smooth film operation.

32. Mechanical slit gauge. For adjusting the length and width of the scanning system slit to prevent discrimination against different types of sound tracks.

33. Projector head alignment tool. For exact alignment of the picture projector with the sound projector so as to insure a free, undistorted film path between the two.

34. Special extension wrench. For checking tightness of screws in inaccessible parts of the sound reproducer.

35. Spanner wrench. Special wrench required for dismantling 707-type drives and for installation of fibre drive gears.

36. "Mechanical fingers". Special tool which will literally go around corners to quickly get at inaccessible screws, bolts, nuts and washers.

37. Sprocket puller tool. For removing sprockets, particularly sound sprockets which must fit tightly on their shafts to prevent flutter.

38. Brush cap tool. Specially designed tool to facilitate the checking of brushes, brush caps and commutators without dismantling drive motors.

39. Oil seal installation tool. For stretching porpoise hide oil seals for installation on projector drives.

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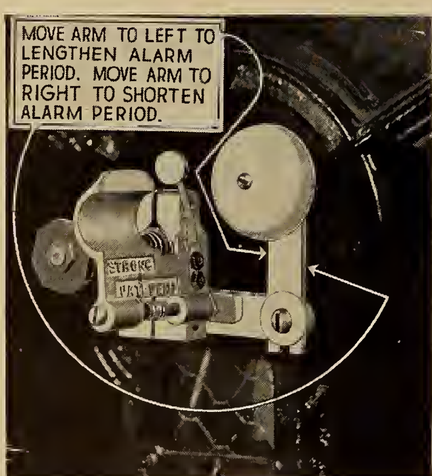

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Edited by James J. Finn

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Monthly Chat

THE new inclusive service plan sponsored by Altec Service Corp. has excited the interest of many projectionist organizations throughout the country. Various interpretations have been placed upon this Altec move, which, if it meets with success, will undoubtedly be emulated by other servicing organizations, notably RCA.

Altec asserts vigorously that the operation of the plan will be an aid to better projection and conducive to more efficient room operation, especially in the matter of speedier replacement of worn and defective parts. Some skepticism anent this new contract pervades projectionist ranks, as is indicated in advices to I. P., thus making it desirable that a comprehensive and detailed statement relative to the operation of the plan be forthcoming from its sponsors.

Altec has accepted an invitation by I. P. to state its case in these columns, so keep your eyes peeled for this important contribution to appear in the next issue. Meanwhile, I. P. will welcome expressions of opinion from the field, irrespective of which turn they take.

• •

Projectionists should clamp down on their congressmen in Washington to register a "nay" vote on the Neely bill, or the sheriff will be clamping down on innumerable picture theatres in these United States. This warning is directed at you, you, and *you.*

• •

A nice man from the Phillips works at Eindhoven, Holland, visited with us for a spell the other day. Said that there still remained beaucoup work to be done on mercury vapor lamps for motion picture projection work, but added that he hoped to put on a creditable showing in N. Y. City soon. We shall see.

• •

New York's Mayor LaGuardia, trying to wean some production work East, says that Gotham can make pictures "just as good as those turned out in Hollywood." Coming from the town's Mayor this is abuse indeed.

• •

Ben Schlanger, big sight-line man, has been creating a bit of stir around Manhattan with a couple installations of his splayed screens—that is, screens without the conventional black masking which permit the projected light to splay off on all sides. Pretty sight it is, too, particularly with color film. Ben promises to tell us all about this number next month.
(p.s.: this is his fourth promise.)

• •

P. A. McGuire ("Mac" to thousands of projectionists) is feeling none too forte these days at his Long Island home. Notes from some of Mac's innumerable friends might do him a world of good.

INTERNATIONAL PROJECTIONIST

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'It Can't Happen to Me'—But It *Has* Happened to Others

By *LEROY CHADBOURNE*

FAMILIARITY breeds contempt; projectionists have had more than ten years now to become familiar with the idea of having six or eight hundred volts around—as familiar with such potentials as Jerry Crowley, radio amateur, who tells exactly what his physical sensations were when he was nearly killed by "a measly little 600 volts." Everyone who has ever taken a real shock and remained conscious through it will agree that if his sensations weren't like Jerry's, they were worse.

Here's how it feels like, gentlemen:

"I stood there petrified, the muscles of my arms gradually contracting. Hot waves chased themselves through my chest, to be replaced by a feeling as though an iron band were being tightened around it! I tried to call out, but the words died in my constricted throat. I could see clearly: Ron was still working at the auto radio set, entirely unaware of the near-tragedy being enacted at his side.

"I was slowly forced backward a few steps, and hoped that the connecting wires would be pulled off and break the connection. I tried to help that movement, but my legs were not my own. My nervous system was completely paralyzed by that *contemptible* 600 volts flowing through my chest. My shoulders were soon against the back wall, and the wires still held. Could no one see what was happening to me?

"Everything now was a swirling red fog, but in the center of the fog I could still see Ron, and now he was looking straight at me, a funny expression on his face. His lips were moving, too, but I could hear nothing but a frying noise that I knew was my own flesh!

● Going 'West' at '600'

"Ron started slowly down the bench, pulling out all the a.c. plugs as he came to them. It seemed to take hours before he reached the plug that would release me from that constricting band around my chest. I saw him reach the plug, take the cord in his fingers, and watched his arm slowly pull it from the socket. Then the red fog became black, and swirled over me completely!

"There was a transformer that couldn't stand up under a 100 ma. drain, a filter condenser that went 'west' at a thousand volts, and on top of them a careless ham who had thrown the wrong switch and almost went 'west' at 600. Faraway voices buzzing around me intruded into my peaceful oblivion. I couldn't open my clenched fingers.

"'I'm alright now,' I mumbled several times to make sure they heard me. I couldn't be sure I was really there in the room with them. There was no pain, no feeling of any kind. I just sat there on the chair dumbly, someone behind me holding me by my shoulders, and someone else trying to push a lighted cigarette into my mouth.

"I was home in bed before I began to feel the burns on my hands and the bruised shin where the chassis had struck me when it fell. That was when the chills and fever started, too. The heavy blankets I was wrapped in couldn't keep me from shaking until my teeth rattled.

"The next day I felt normal, except that I could hardly move my arms. It was a week before I could lift a cup of coffee with only one hand. Measly little 600 volts, indeed! A steam roller

Radio for Nov. 1939.

couldn't have done a much better job of flattening me out.

"The burns have healed now, and the arms are alright again, but believe me, every time I stick my hands into a transmitter I make certain the *right* switch is turned off. I try also to follow this advice: When you stick your hand in where there could be voltage, even though you *know* there isn't, go in with the back of your hand first, and the other hand in your pocket. If you get bit then, your hand will naturally pull away from it."

● Projection Work Differs

Projectionists, with whom electricity is a business, not a hobby, will agree that while the advice is good, it doesn't always apply to their craft. There are times when theatre men *must* go into "hot" circuits. In chasing trouble, for example, with an audience booing and catcalling, it doesn't help matters much to apply voltmeter leads to "dead" terminals. And circuits used in this business ordinarily run from the "measly" 600 volts that socked Jerry up to 1000, with 1500 volts or better in some of the larger equipments. It is interesting to note that voltages used in prisons for electrocution are often no higher than 1800.

The projectionist, not being an amateur, has to handle such wires "hot." He has been doing it for quite a few years. Jerry explains that he also had been handling high tension for years, and that doubtless was why he became careless about throwing off the vitally important switch.

Further, television, when and if it comes to the theatre, will bring with it (according to existing apparatus designs) operating voltages in the neighborhood of 50,000. The present would seem to be a good time to think about forming safety habits.

Fortunately, safety measures are entirely practical, even in fast repair work, provided the worker has not only thought about the subject in advance but has also formed habits that will stay with him when he is too busy to think of them. The writer was kicked by 10,000 volts once. Once! He has been around electrical apparatus for a fair number of years since, and done considerable projection room servicing under emergency pressure, but in this respect experience proved to be a great teacher.

All the rules for safe electrical work are the product of common sense, plus experience. "One needs not so much to be told as to be reminded." The most obvious rule is the one most often violated. It can be put this way: *never handle a hot circuit if it is possible to work with it cold.* Projectionists, like professional electricians, often test for continuity by putting a finger—sometimes a moistened finger—into a 110-volt socket, or by bridging a finger and a thumb across the blades of a 110-volt switch. It seems so safe: all that happens is a slight tickling sensation in the fingers. It is safe—until the time, sooner or later, when the man doing it happens to ground some other part of his body, whereupon the current instead of passing in and out of a finger completes its circuit through a few vital organs.

● Body Shock Capacity

Tests have been made as to the amount of current a man can stand without undue distress (which at 60 cycles happens to be 5 milliamperes). At 11,000 cycles 30 mils is tolerable, and much greater currents at higher frequencies. Tolerance to d.c. is less. Note, therefore, that at 600 volts, 60 cycles, 6 mils will pass through a body resistance as high as 100,000 ohms, as anyone can figure for himself by Ohm's Law.

The body resistance is of course mostly skin resistance; the internal parts are bathed in salty fluids which make good conductors. When the skin resistance is lowered by perspiration or other moisture, or by any very firm contact with metal or ground, the body may offer considerably less than 100,000 ohms to the applied voltage.

Safe practice involves the invariable rule of using a lamp or other tester on sockets and switches, in place of fingers. Ninety-nine times fingers are perfectly safe, but the hundredth time must come sooner or later.

Safe practice involves testing "dead" circuits instead of "live" ones wherever possible. Hence in sound reproduction work the ohmmeter, which supplies its own operating voltage (one volt or so) is to be preferred to the voltmeter whenever the choice is possible.

Safe practice involves making sure that a supposedly "dead" circuit is really dead. If there are two switches in series, open *both.* For example, a sound amplifier may have an on-off switch in its panel, and may be supplied through another switch in the power switchboard. In working on a sound amplifier the writer prefers to use the double precaution, and anyone who thinks that this is being overfussy is welcome to keep thinking so until he gets a first-rate shock himself. It is worth remembering that it is not only very possible to make a mistake about opening the right switch, but also that if it has been opened, someone else may come along and by error close it again.

The precautions necessary to make sure a dead circuit is dead are elementary and easily made a subconscious habit that will become automatic in any emergency. But very often there is no choice except to work on a "live" circuit, particularly in the case of rush repairs, and for that purpose a number of precautionary measures must be planned and thought about in advance until they also become habitual and automatic.

First of all remember that the current acts by paralyzing the nerves and muscles, so that very often the victim *can't let go!* The oldtime electricians had a widely known rule-of-thumb to the effect that "A.c. throws yah, but d.c. holds yah." It works that way sometimes, and in general d.c. is somewhat more dangerous than a.c.

But a.c. can paralyze very effectively. Consequently, do not *grasp* a doubtful conductor—or any ground connection or metal that may be grounded. *Touch* them, and in such a way that if the muscles of the hand are contracted and paralyzed by the current, the hand will not close around the conductor. That is the meaning of the foregoing advice to go into doubtful apparatus with the *back* of the hand. Keeping the other hand in your pocket limits the

---

Kill Neely Bill, Advise 350 AFL Locals in New York City

CENTRAL Trades & Labor Council of New York, comprising 350 locals of the A. F. of L. has made a slashing attack upon the so-called Neely Block-Booking Bill which has already passed the U. S. Senate and will come up for a vote in the House soon. I. P. has advised vigorous and unrelenting opposition to this bill and has suggested that every projectionist group register opposition thereto with its congressman. Partial text of the N. Y. statement follows:

> "The measure has been introduced ostensibly to prohibit the practice known as block-booking, . . . but the bill, stripped of its camouflage, is designed to increase tremendously the risks taken by the producing companies. . . . It will mean the destruction of the jobs of workers employed in the studios and, at the same time, the shuttering of thousands of motion picture theatres for lack of sufficient product, with a consequent loss of employment to projectionists and other workers in the theatres. The measure seeks to give to the exhibitor far less freedom than he now possesses. Under the Neely bill the exhibitor cannot get out from under an agreement to show in his theatre a given picture. This is in contrast with the existing situation, which permits the exhibitor to cancel freely. . . .
>
> "We are going to do everything within our power to kill this bill, which will do great damage to a major American industry but will solve none of the serious problems and difficulties of that industry."

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possibility of an accidental contact with ground.

Use Insulated Tools

Next, in working on any live circuit, even a "safe" one, use insulated tools. There are screwdrivers that have all-wooden handles, and others in which the wooden handle is pierced by steel rivets that make internal contact with the blade. The latter might as well have all-steel handles, for any safety they afford. Insulated screwdrivers, pliers with rubber-insulated grips and similar tools are common and inexpensive. Where they are not available, insulation is easily provided by gripping the tool through a thoroughly dry handkerchief. After it has been used for a while it may become moistened by the perspiration of the hand and be less reliable. An oil-soaked rag is very safe, provided it really carries oil and not a mixture of oil and water.

Test-prods supplied with voltmeters, multi-meters and similar circuit testers are of two types—insulated for low voltage and for high voltage. Only the latter should be used around sound equipment. The prods should be long, so they can be inserted into a panel or cabinet without the hand following them in. Working with unprotected tools is not only dangerous to the projectionist but it is also a source of possible short-circuiting that may damage apparatus and add to the troubles under investigation.

Remember the filter condensers in working on any amplifier or other rectifying unit. They carry a charge at the filter output voltage, sometimes at considerably more than the filter output voltage. Some filter circuits associated with rectifying equipment are wired with bleeder resistors through which the charge leaks off and dissipates itself shortly after its source has been disconnected; but others are not so designed and may retain the charge in their condensers for many hours. The charge may be heavy enough to kill, but where it is not, the man contacting it may still be badly hurt because the sudden involuntary contraction of his muscles is very likely to "throw" him with considerable force against any of the hard objects that are common around a projection room.

Fuses are sometimes a protection in working on a live circuit. This is less true of ordinary power fuses, because, as noted, a very few milliamperes are enough to produce serious shock when they penetrate the skin resistance. Sound power circuits are often equipped with midget fuses or grasshopper fuses that do offer some degree of real protection. Where the nature of the work to be done allows, it is helpful to leave such fuses in place.

In many electrical investigations it is practicable to work safely on a live circuit by "killing" it temporarily. This is especially true when test equipment is to be connected. If time allows, and if it is not too safe to apply test prods or clips to live terminals, switch off the equipment, make the needed connection, and switch on again. This may involve some slight delay until tubes and other parts warm up to normal operating temperature.

Use of Instruments

The ohmmeter, since it supplies its own small voltage and works on apparatus which is not at the moment carrying any other voltage, is safest. The voltmeter should be applied either through long well-insulated prods, or by switching off the apparatus temporarily.

Headphones in general should be applied in the same way as the voltmeter, although, when it is known *definitely* that they are being applied to a speech circuit, in which other voltage cannot possibly exist, precautions are not necessary. However, when the phones are used in tracing trouble, remember that the trouble may be caused by other voltage getting into a speech circuit, and be careful with phones accordingly.

The output meter or volume indicator is usually connected to circuits in which the possibility of encountering dangerous voltage is just about nil, and therefore seldom calls for any precautions. The same is usually, though not always, true of the oscilloscope. The oscilloscope, however, may carry fairly high voltages in its own internal circuits.

The audio-frequency test oscillator can generally be connected to the sound system without special precautions. Its internal circuits may or may not carry voltages involving safety requirements.

Testers applied to line power circuits are in most cases simple trouble lamps or neon indicators. These are usually well enough insulated, particularly if one takes ordinary care not to ground one's body.

Grounding must be guarded against in all electrical work. Ordinary clothing is sufficient insulation, but ground may be contacted through the other hand, especially if the projectionist should slip and reach for something to hold to, through an arm or elbow

(Continued on page 29)

"No Gentle Breezes Blow"

YOUR Broadway, Hoboken and Des Moines correspondent who has been making the rounds of the pix houses to determine what, if any, affect the European war is having on the theatre business, found that the war is just a quiet little shindig compared to the practically ceaseless battle between the union projectionists, the theatre owners, and the house managers.

The composite manager says: "War! Say, I've been fighting the owner of this house for two years to get a raise. I open the doors at eleven in the morning and finally turn out the lights at about midnight. I have to see that the films arrive on time. I have to keep the kids from tearing up the seats or staying through six shows. I have to handle the bingo and bank night, which would put an ordinary man in the psychopathic ward in two weeks. In addition I wake up any drunks that might have wandered in for a little shut-eye.

"I have to keep my eye on the screen so I can awaken the projectionist when the picture is out of frame. I have to watch the time to be sure the show does not run ten seconds over schedule or the projectionists will demand overtime.

"My home life is practically non-existent and the owner of this shooting gallery falls in a faint or shouts 'ingrate' when I ask for two dollars a week more.

"Don't talk to me about war in Europe!"

Glorified Janitor and Redhead

The theatre owner: "So the glorified janitor that calls himself the manager says he's underpaid. Twenty dollars a week I give him and the only thing he can do without supervision is point out the ladies' room. He can't even put stills in the frames rightside up.

"His daily report looks like a Chinese broadside and is just about as intelligible. He is at the corner drug store every hour on the hour huddling over a cup of coffee and dishing out passes to the red-headed casbier.

"If, and when he shows me he can increase tbe attendance, I'll not wait for him to ask for a raise; I'll give it to him. Ideas with him are as scarce as a fulfilled film salesman's promise.

"And those gorillas in the projection room! Don't talk to me about a war in Europe."

'Black Hole of Calcutta'

The projectionists: "War in Europe! Say, they don't know what fighting is until they've gone to bat with the owner of this slave block.

"This Black Hole of Calcutta that he calls a projection room runs the temperature to about 200, and do you think he'd buy a fan! If he had to spend eight hours a day here he'd soon lose that bay window of his.

"He brings his deaf aunt to the show twice a week and we have to turn up the sound so loud it blasts everyone's ear drums just so the old lady won't forget him in her will.

"And generous! Say, he'd trade you a peanut for an orange any day in the week. If we didn't have a union he'd have us chained to the machines and throw us a bone every time tbe bank nite jackpot was hit. War!"—*Exhibitors' News and Film Curb.*

Television Developments in 1939: Status of the Art Today

By *DR. W. R. G. BAKER*

GENERAL ELECTRIC COMPANY

TELEVISION is still an engineering achievement and a commercial enigma. The actual sales of television receivers have been extremely limited. Many reasons have been advanced and all are undoubtedly correct to a degree. Some of the causes advanced for the negligible consumer acceptance, so far as purchases are concerned, are the limited program hours, the type and quality of programs, the list prices of receivers, and the relatively short trade discounts as compared to radio.

Nevertheless, and in spite of the limited sales, it is the general opinion that the N. Y. experiment has demonstrated that television service can be rendered over the area originally estimated, and that given acceptable programs, such service provides real entertainment value and opens up new educational possibilities.

From the technical viewpoint, the experiment of moving this new art from the laboratory into the business world and actually reducing it to practice in the form of an experimental service, must be considered an almost unqualified success. From the business viewpoint, television has not produced the favorable results anticipated. It is quite probable that the solution of the business problem awaits further technical advances which will permit appreciably lower list prices for television receivers.

Relay Station Possible

It is generally recognized that the high cost and great difficulties involved in television program production introduces one of the formidable barriers to a wide adoption of television as a general form of entertainment. To reduce the number of programs required, some method of interconnecting stations is required. But since television can serve only the densely populated sections of the country because of its limited signal range, and since such sections are frequently widely separated, the problem involved in the interconnection is difficult. At the present time a chain of relay radio stations seems to be the most practical method of accomplishing this.

During 1939 preliminary tests and development work on a relay station to pick up the television broadcasts from New York City and relay them to the Albany district through the main G. E. transmitter was completed. These tests indicated that such a procedure is possible, and disproved the common previous conception concerning the propagation of these ultra-high-frequency waves.

As a result, a television relay station is now under construction in the Helderbergs about 1½ miles south of the main television transmitter. By means of this station the Albany district will be supplied with television programs which originate in New York City as well as those from the studios in Schenectady. This project is one of the first of its type and will in effect be the forerunner of television chain broadcasting.

Television Receivers

Two distinct groups of television receivers were produced in 1939. The first of the two receiver groups included 12-inch and 5-inch picture tube models, none having standard broadcast band receivers included. The 12-inch models were all console types with a mirror in the cabinet lid for indirect viewing of the picture tube screen. They varied only as to loudspeaker and cabinet design, one series (GM-295) being distributed in the Schenectady - Albany - Saratoga area served by the Helderberg transmitter, one series being purchased by the Columbia Broadcasting System, and the third series being placed on display at the N. Y. World's Fair.

These receivers are provided with seven television station selector buttons and a power-off button. There are also five picture and sound adjustment controls next to the selector switch, including picture brilliance and contrast, vernier station tuning, and sound tone and volume. The 5-inch picture tube model in the first receiver group produced both picture and sound. Five station selector switch buttons and six picture and sound controls are provided on the front of the cabinet, where the picture tube screen is also located for direct viewing. Several of these models were also displayed at the Fair and distributed in the Capital District area.

The second group of 1939 television receivers were built for general commercial sale and included 5-, 9-, and 12-inch picture tube models, two of the 12-inch types being equipped with standard broadcast sound all-wave receivers. The pictures are viewed directly on all models except one.

The lowest-priced 5-inch receiver produces television pictures on any one of three channels selected by push buttons on the front of the cabinet, but does not contain a loudspeaker, television sound being obtained by connecting the audio sound terminals to any standard broadcast receiver. Four picture controls, including brilliance, contrast, focus, and vernier station tuning are located under the screen. The other 5-inch tube model (HM-185) is a console with sound. Three television channel selector buttons and six picture and control knobs are located on the front of the cabinet.

A 9-inch model is a console. Picture detail is naturally much greater

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RCA's Theatre Television

RCA will introduce "improved projection of large-screen television images, of a size adequate for theatre presentation" this year, it was announced by David Sarnoff, RCA president, in his year-end statement. With the FCC's approval of limited commercialization of television virtually assured, RCA's announcement presages a lively race, for, in addition, other leading companies—General Electric and DuMont, notably—for some time have been working on large-screen tele. DuMont, it is understood, proposes a screen considerably larger than the 9 by 12 foot screen with which most companies are concerned.

Baird, which demonstrated its large-screen television last summer, again is said to be seriously considering the possibilities of the American theatrical market.


IN GYMPIE OR GIBRALTAR, IN SINGAPORE OR RIO
NORTH ATLANTIC OCEAN
West Indies
CARIBBEAN SEA
VENEZUELA
COLOMBIA
GUIANA
ECUADOR
SOUTH AMERICA
BRAZIL
MOROCCO
ALGERIA
FRENCH WEST AFRICA
ERPI'S HELPING HAND
is welcomed 'round the world!
ERPI's foreign service is truly world-wide ... over 1200 employees, working out of 25 main and 75 service offices ... taking expert care of Western Electric equipment abroad in 4600 theatres and 20 studios.
And all this in addition to the job at home.
ERPI, backed by Bell Telephone Laboratories, will continue to pioneer in *scientific research*... improving apparatus for recording and reproducing sound pictures ... helping to assure the continued growth and prosperity of the industry!
Electrical Research Products Inc.
SUBSIDIARY OF
Western Electric Company

in this larger screen model than in the 5-inch receivers, and sound reproduction is better in quality and volume. Five station selector buttons, a power-off button, and six picture and sound controls are provided.

The next receiver in performance and price range is a 12-inch model equipped for standard all-wave broadcast as well as for television. Pictur screen, television picture and sound controls, and broadcast receiver controls are located on the front pane: Five television station channel buttons, a power-off button, and six picture and sound knobs control the television receiver. A three-band tuning dial with rotor type volume and manual tuning controls, rotary switch tone type and band controls, and push buttons for stations and phonograph pickup operate the broadcast receiver.

The utmost in picture clarity and detail and in sound reproduction is made available in another 12-inch model. Standard broadcast operation is provided. Controls are located in the top of the cabinet under a hinged mirror lid. A large mirror makes possible in direct viewing at wide angles. Seven station selector buttons, a broadcast receiver changeover button, and power-off button are located at one side of the screen. There are also six picture and sound controls.

● Studios Set to Go

Cameras, microphones, a film projector, studio and control room apparatus, picture transmitter, sound transmitter, and antennas—all fully conforming with RMA standards—were produced as parts of a 1-kw transmitter and flexible studio equipment. The equipment is so designed that, should it later be desired to increase a station's rating from 1 to 10 kw, no equipment need be discarded or replaced.

The camera and its mount provide means for the quick, accurate focusing and easy, smooth maneuvering so necessary if action is to be followed well in close quarters. The studio microphone is a high-fidelity velocity type with adjustable bi-directional, uni-directional and non-directional characteristics to care for the various contingencies arising in program production.

The television moving picture film projector, synchronizing automatically and providing steady pictures, converts the standard motion picture film speed of 24 frames per second to the television standard of 30, with two field interlacing at a vertical picture stability of 0.125 per cent.

The studio control equipment provides a picture definition of 441 lines, corresponding to a frequency band from 0 to 4 megacycles; provides for a maximum of six channels and the means for switching instantly or for fading gradually from one channel to another; and has full monitoring and automatic brightness control, which supplements the manual control and accurately maintains the "black" level during sudden background changes.

The picture transmitter features low-level modulation, greatly reducing equipment size and power loss. The sound transmitter is a high-fidelity unit having an audio channel from 20 to 15,000 cycles. The cubical-type antenna, comparatively easy to adjust and feed, efficiently directs the radiated energy along the earth in all directions to the antennas of the television audience.

For home television receivers there were produced two types of dipole antennas, small and light but sensitive over a wide frequency band. When maximum sensitivity and directivity are required, one may be augmented with a reflector. In the first line emphasis was placed on compactness, lightness and low cost. The fundamental unit of this line is a wood and metal dipole, 8 ft. long, which tunes to an equivalent of 10 ft. of length.

The second line was designed with the idea of producing the best antenna possible. Its fundamental unit is a metal dipole 10½ ft. long, of high sensitivity. A balanced array of 4 dipole units was also produced for regions of low signal and high local noise levels, where requirements are most severe.

New D. C. Arc (40 amps. at 27½ v.) by Strong For Small Houses Uses Vastly Improved Suprex Negative Carbon

THE campaign to raise the level and improve the quality of screen illumination in small- and medium-size theatres (400 to 900 seats, having screens up to 18 feet) entered a new phase with the recent announcement of a new Suprex D.C. projection arc lamp, rated at 40 amperes and 27½ volts, which, judged on the basis of performance, ease of operation and economy, rivals the best efforts to date in this field.

Two such lamps are now available: the Strong Utility High-Intensity, and the Simplex High-Intensity. The other lamp manufacturers have not as yet revealed their intentions, if any, in this direction.

Of primary interest in connection with this new lamp is the comparatively low current rating for the regular Suprex carbon trim of 6 mm. negative and 7 mm. positive which is used. Heretofore this size trim could be burned efficiently only in the range from 48 to 50 amperes; at the low current rating of this new lamp the old-type Suprex negative would be tipped with carbide and thus produce an unstable arc, with consequent color changes, and periodic flare-up.

● Improved Negative Carbon

National Carbon Co. took this 6 mm. carbon and, after prolonged research work, improved it to a point where it can now be burned at a rating of 40 amperes and 27½ volts without forming even the slightest trace of carbide. This new Suprex carbon, known as the National Orotip C, has just been put into quantity production. Because of the low current density, the 7 mm. positive burns at a rate of only 5.9" per hour, thus permitting the showing of six double reels (approx. 1800 feet) per hour. The 6 mm. negative burns at a rate of 3¾" per hour. This Suprex trim costs no more than it did before this great improvement in quality was effected.

This new lamp resembles a low-intensity job, but there the resemblance ceases. The former has an electrically-different type arc control, a full floating positive jaw, and a positive carbon guide to maintain the crater central with the reflector, an indispensable necessity for good Suprex operation. It has an illuminated ammeter, arc imager, quick arc striker, and all the other advantages of a well-fitted job. It can be used with any standard projector equipment.

Because of the low current density at which these carbons are burned, perfect feeding can only be attained, according to the manufacturer, by the use of a rectifier which supplies a direct current that increases and decreases sharply with the exceptionally small variations in arc gap length.

This new lamp, with its associated rectifier equipment, is sold only as a unit because, the manufacturer states, the new carbons have peculiar characteristics and will not feed to maintain a uniform arc gap length or focal position of the positive crater when current is applied to the arc by any other than the special rectifier designed for this lamp.

These rectifiers are available in three

(*Continued on next page*)

models for either single-, two-, or three-phase 220 volt a.c. line service. Each rectifier employs four 15-ampere tubes to supply a total lamp load of only 40 amperes at 27½ volts, which load is so far below the rated tube capacity as to assure exceptionally long tube life.

Strong Electric Corp., the manufacturer, has in mind for future development a copper-oxide rectifier for those who prefer this type of power supply. Negotiations with motor-generator manufacturers are under way looking to the building of sets with the built-in electrical characteristics necessary to the satisfactory operation of this particular arc. The tube-type rectifier is favored at present because of its small physical dimensions which permit its placement on the floor directly under the lamphouse and make for a simple, low-cost wiring job.

● Cost—and What For

Any discussion of projection equipment for the small- and medium-size theatres would of course be incomplete without some reference to costs—original, operating and maintenance. Preliminary estimates relative to this new 40-ampere D.C. Suprex job indicate that it stacks up very well economically with any equipment delivering anywhere near comparable results.

List prices on projection equipment of course have long been more concealing than revealing of the true state of affairs, yet there is no other possible basis for figuring comparative costs. Therefore, in terms of list price this new 40-ampere job compares very favorably with any other equipment having capabilities even approaching the results obtainable with this new D.C. job. "Lumens per dollar" is the all-revealing phase, of course, to which should be coupled, in situations where the prospective purchaser is particular about screen results, consideration of "what kind" (quality) of light—that is, how steady and of what color.

This new 40-ampere job being a Suprex D.C. unit, all readers of I. P. of course know the answer to the latter proposition, that is, with reference to steadiness and color. Other costs items anent this new job constitute very interesting figures.

Preliminary tests (the results of which will be checked further and, if not sustained thereby, announced in these pages) indicate that the carbon burning rate per hour is 5.9" for the positive and 3.75" for the negative. Allowing for a 1½" stub (which figure could be reduced if the essential steadyrest were eliminated), the total hourly carbon cost is approximately 7½ cents. Add to this a power cost of 7½ cents, and we have a total operating cost for carbons and power of 15 cents an hour.

Now arises the question of what one gets for this cost. Considering the efficiency of the rectifier, it is apparent that the total line watts input approximates 1940, which is a respectable figure in any league, and particularly so in view of the results obtained. Tests indicate that 2000 screen lumens are obtainable with the shutter running.

The foregoing data, as stated previously, are in the nature of a preliminary report on this new arc lamp. A more detailed exposition of the subject will appear in the next issue of I. P., the worth of which would be enhanced considerably by interrogatory comment from the field anent this equipment.—J.J.F.

Local Union Elections

LOCAL 186, SPRINGFIELD, MASS.

Local 186 recent election marked by the re-election for the 28th time of John F. Gatelee as Business Representative. Gatelee just recently finished an extended tour of I. A. duty on the West Coast studio situation. Other officers named are: President, Benjamin Hull; vice-president, Louis Williamson; sec.-treas., Arthur Payette; executive board, G. G. Best, Evan T. Elia, and Sam Small; sgt.-at-arms, Joe Rodriguez. Delegates to Springfield C. L. U., Messrs. Gatelee, Hull, Rodriguez. Small and Holmes; to the Westfield C. L. U., Messrs. Gatelee, Hull, Best, Morris, and Heathcote.

Delegate to the I. A. Convention is J. F. Gatelee, with B. G. Hull as alternate.

LOCAL 650, WESTCHESTER, N. Y.

All present officers of Local 650 were re-elected by substantial majorities, and the term of office was extended to a term of four years in the recent Westchester County, N. Y., election. Officers are: Arthur Martens, president; Irving Weiss, 1st v.-p.; A. Dente, 2nd v.-p.; Irving Brickman, 3rd v.-p.; Dick Hayes, business representative; Albert Bell and George Alley, trustees; Fred Thome, financial sec.-treas.; Emil Smith, recording and corresponding secty., and Lawrence Sabatino, press secty.

LOCAL 182, BOSTON, MASS.

Results of an election in Boston Local 182 is a refrain, not a report, it being possible to hold the type from year to year and still accurately reflect the results. So, once more we start off with the news that Thad Barrows has been re-elected president of Local 182 without opposition, for the 24th consecutive time. The estimable Jimmy Burke (need it be said?) will continue as business representative.

Other old-liners are also on view: Bernie McGaffigan as vice-president, Joe Rosen as treasurer, and Al Moulton as financial secretary. Joining the aforementioned on the executive board are Louis Pirovano, Joe Nuzzelo, and John Deihl.

LOCAL 306, NEW YORK CITY

Joe Basson was again named president of Local 306, but the big news of the recent election is the return to power in the Local of the Sam Kaplan forces, which gained every significant office, except the top slot, and including a majority of the executive board. Kaplan himself was the top vote-getter for the board.

Other officers elected are: Morris Kravits, vice-president; H. Gelber, recording secretary; C. Beckman, financial secretary; J. Ambrosio, treasurer; Bert Popkin, b. a. for N. Y.; Jack Teitler, b. a. for Bklyn. Board membership includes Messrs. Cancellare, Costigan, De Sena, D'Inzillo, Eichhorn, Stewart, and Storin.

LOCAL 488, HARRISBURG, PA.

Lawrence Katz was reelected president for the 11th consecutive time. Others named: Horace Gladfelter, vice-president; M. C. Miller, secretary; P. F. Patterson, treasurer; Samuel Ruben, business agent; Charles Reed, John Brunner, executive board; A. V. Morgan, H. M. Michaels, Clarence Rudy, trustees; Lester Firing, sergeant-at-arms.

NEW CARBON ARC FOR 16 MM. KODACHROME PROJECTION

Bell & Howell announces a new carbon by National Carbon Co. which is of major importance to the projection of 16 mm. Kodachrome film. It should be remembered that Kodachrome is essentially a one-shot proposition and should in no way be confused with the characteristics of Technicolor or other 35 mm. color film used in the professional field.

The majority of 16 mm. projectors in use are equipped with incandescent lamps the light from which is much stronger in the orange and red end of the spectrum than in the violet and blue. This factor is taken into account in the processing of Kodachrome and similar 16 mm. color film. The 16 mm. arc projector is designed to meet the need for a projector where an incandescent light source is not strong enough to do a satisfactory job.

Even Spectral Balance

The fact that the color film developed for general use in 16 mm. projectors favored the incandescent light source in its characteristics presented a problem with such an arc projector. An arc source was required that would do justice to the color values of this film. The high-intensity arc, preferred for the projection of color features in the theatre, gives a snow-white light indicating an even balance of all colors of the spectrum, and the 35 mm. film supplied to the theatre is processed for use with this quality of light.

The 16 mm. color film, however, called for a different type of arc. By the proper combination of shell and core materials it has been possible to vary the spectral energy distribution of the light from the carbon arc sufficiently to give a true reproduction of colors from a film that has been processed for use with an incandescent source of projection light.

SIMPLEX 4-STAR SALES

National Theatre Supply Co. announces the sale of 135 complete 4-Star Simplex Sound Systems in the 11 weeks dating from Oct. 2, together with many sound modernization jobs. Outstanding jobs in this direction, according to National, were turned in by J. I. Roberts, Memphis, with 13 sales; H. Hunt, Cincinnati, with 8; W. J. Turnbull, Detroit, with 10; Harry Blumberg, Philadelphia, with 8, and J. Frank, New York, with 10.

Three-Dimensional Motion Pictures: A Review and Forecast

By *JOHN T. RULE*

Present two-dimensional pictures are possible only because of the extreme sluggishness of the muscles of the eye—a plain case of "tricking" the observer into believing that he is viewing a non-interrupted series of pictures. This ingenious ruse will have to be considerably improved upon before three-dimensional movies are developed to the point where they are generally acceptable to paying audiences.

This does not mean that acceptable "depth" pictures are impossible to produce; quite the contrary is true. But the road ahead is rocky, and the demand upon human ingenuity extremely severe, before this goal can be attained. All of which is engagingly detailed in the accompanying article.

IN ANY painting or photograph, the greater the illusion of depth the more intense is the effect on the observer. In painting, the development of perspective and the use of increasing blueness and decreasing detail with distance did not grow out of any desire to imitate reality but out of an appreciation of the esthetic power of depth.

The stereograph instantaneously and effortlessly produces an effect which painters have strained to achieve by a thousand different means — three-dimensional art. In photography as soon as an individual becomes accustomed to this quality, a two-dimensional picture becomes a very pale and unsatisfactory substitute.

Curiously enough we are dealing with an unusual paradox, for, physically speaking, or, rather, physiologically speaking, there is no such thing as the visual perception of depth.

Fooling the Brain

Perception of distance away from the eye can be nothing more than a mental interpretation, performed by the brain, of the disparate evidence of two flat pictures obtained by the two eyes. Fortunately the interpretation may be completely in error. I say fortunately because the process of fooling the brain forms the basis of all three-dimensional photography.

Glance with the left eye only through a glass window at a landscape. It is perfectly conceivable that a master painter could reproduce on the surface of the glass an exact duplicate of the outside world. The painting, would, of course, include those factors from which the eye has learned by experience to infer depth—perspective and increasing blueness and decreasing detail with distance.

The substitution of the picture for the landscape would not in any way alter the image received on the retina. The only physical change would be a change in the shape of the crystalline lens of the eye as it refocussed on the shorter distance to the picture.

If a single eye has any direct ability to judge depth it must therefore result from a correct interpretation by the brain of the change in muscular tension which alters the shape of the lens. It is easy to demonstrate experimentally that the brain either does not make such an interpretation at all or that it is so minor a factor in depth judgment that it is rejected in favor of purely experiential evidence—perspective, known size of objects compared with apparent size, and the like. Consequently the vision of a single eye must be strictly two-dimensional.

The aforementioned process can, of course, be repeated for the other eye to obtain a second picture for that eye. It should be noted that the two pictures will not be identical. The right eye sees more of the right side of space objects, and the left eye more of the left side. A post in the foreground of a scene obscures different portions of the background for the two eyes. Our two plane pictures must of course record these variations.

Mutually Exclusive Views

One major difference between the space scene and the two pictures presents itself. In viewing the scene each eye receives only the image registered from its position. If we had our two paintings on the glass, each eye would normally see both paintings. Consequently we must devise some method which will enable each eye to see only that picture which is intended for it.

Having done this we have reproduced by means of flat pictures two retinal images which in no way differ from those received from the space scene itself. There will then be nothing to enable the brain to tell the difference, and it will therefore interpret the two images in its habitual manner as a true depth scene.

In accomplishing this in practice, the proper pictures may be obtained by placing camera lenses and making exposures at the points where the eyes should be. After that the picture must be properly presented—that is, placed at the distance from the eyes that makes them subtend the same angle as the original scene.

They must also be properly separated. The degree of separation can be determined from the separation necessary between the two views of any point to make the lines of sight from the eyes through these views intersect at the proper distance in space. Finally, the pictures must be *mutually exclusive to the two eyes*. This physical factor has to date dictated that some device, either a stereoscope or spectacles of one sort or another or mirrors, be placed directly before the eyes.

With some such device, however, we have fulfilled all the conditions necessary to deceive the eyes completely into interpreting two flat pictures as a solid scene.

The problem of avoiding some mechanical device at the eyes is the major one of three-dimensional photography. The chance of solving this problem appears on the surface to be practically non-existent. The only theoretically correct solution was worked out by Dr. H. E. Ives in conjunction with Bell Telephone Laboratories—it was estimated that fairly good results could be obtained if fifty cameras were used in taking the pictures and fifty projectors in showing them. The procedure seemed impractical except on a very small scale and the telephone company quite wisely abandoned the project. The search goes on, however.

Many 'Inventions' Fail

The press frequently carries a story of some new invention but somehow none of these has ever materialized. Two were announced in 1938. One

merely claimed to give an illusion of roundness to the edges of objects. The other I have had no time to investigate. The statements of the inventor, however, as quoted by the press, contained nothing which raised in me the slightest hope that a way out of the impasse had been found.

Stereoscopic photography may be divided into two types: the observation of still pictures by a single individual, and the observation of projected pictures by a group of simultaneous observers.

In the early days, still stereographs were extremely popular. Our grandparents almost invariably had a hand stereoscope together with a set of pictures, generally a trip around the world.

The problems of projection and simultaneous viewing may be considered the problems of three-dimensional movies. The only such movies yet shown publicly have been those using red-and-green spectacles. These are known as anaglyphs. Instead of being black and white, the two necessary pictures are respectively red-and-white and green-and-white.

To the eye covered by the green lens the red-and-white picture appears black-and-green, since the red light fails to penetrate the lens and the white light gets through as green. To this same eye the green-and-white picture appears entirely green and consequently ceases to exist as a picture. The reverse is true for the other eye. Consequently the two pictures are rendered mutually exclusive to the eyes. The green-and-red areas fuse and are interpreted as white because of the complementary effect of the colors.

This system has a number of defects. Since green and red are used to produce a black-and-white picture, colored movies are ruled out. Furthermore a dark object in the foreground placed against a white background obscures different areas of the background. Consequently the white area which is visible to only one eye continues to appear the color of the lens before that eye. The fused image of the object is therefore fringed by red on one side and green on the other.

Finally, this kind of stereoscopic movie imposes an eye strain which frequently causes a very severe headache if the pictures are watched much longer than 15 or 20 minutes.

● Polaroid Best Bet

The newest and by far the best projection system involves the use of *polaroid*, a material which polarizes light. The light projecting one picture is polarized vertically while that of the other is polarized horizontally. A pair of ordinary spectacles with similarly polarizing lenses is worn. The eye with the vertically polarizing lens sees only the vertically polarized pictures and *vice versa.*

The difficulties in this method center around the problem of obtaining a light source sufficiently powerful to overcome the great reduction of intensity produced by polarization. High-powered lights produce such high temperatures that the cooling of projectors becomes a problem. This is a difficulty, however, which is rapidly being conquered, and the method presents no other major obstacle. Very excellent three-dimensional movies have already been made with it and I have very little doubt that this is the method that will ultimately be used.

In facing the problem of three-dimensional movies, then, the motion picture industry must first of all consider the matter of spectacles. Either the theatres must furnish each individual with the necessary device or they must expect the public to own it. I believe it will be impossible for a theatre to re-use the same spectacles continually. The cost of such glasses must be reduced to a nominal sum, say ten cents. A moviegoer may then own his own; if he forgets to bring them, he may purchase a new pair at the box-office for a dime.

Many other systems for the showing of three-dimensional movies are possible. A half dozen different methods of using mirrors have been suggested. But they are cumbersome approaches to the problem because mirrors are rather fragile and easily dimmed. Reflecting surfaces, it seems to me, stand little show of surviving in this field.

● Theatre, Studio Requisites

The next considerations are those of initial expense. Theatres will need two single projectors or a double projector plus screens that will not depolarize light. Changes in theatre shape will also be desirable. There is only one theoretically correct position from which to view a stereograph. Any movie viewed from too far to one side makes the characters appear extremely thin. The same effect, greatly exaggerated, or rather, more forcibly brought to the observer's notice, will be produced by three-dimensional movies. Furthermore, to an observer in the back of the house the depth will be exaggerated; whereas to one in the front row the depth will be foreshortened.

Though existing theatres will unquestionably continue to be used, the new ones will probably be rather long and narrow, since the distortions from the side are much more annoying than those from front to back.

The added costs also extend into the studio. Many of the devices now employed to reduce expenses will have to be scrapped. Obviously, for instance, painted or photographic backdrops must be abandoned, for the lack of depth will immediately be apparent. The use of background projection screens, a very common device, will become enormously complicated. The very common picture, for example, of people riding on a bus or in a taxi, with the street scenes moving past, is now being filmed by holding the people still while the action on the street is projected on a screen behind them.

In three-dimensional movies, the image on the projection screen will also have to be three-dimensional, properly polarized, adjusted to the proper depth to fit the required scene and of sufficient intensity to appear real. For the same reason the extensive film libraries of general scenes, such as those of war or crowds, which are now inserted to heighten a desired effect will have to be entirely rebuilt.

It is interesting to speculate what effect three-dimensional pictures will have on the present crop of stars. Many an actress who is two-dimensionally photogenic may find herself three-dimensionally quite unacceptable, and *vice versa.* Probably a normally beautiful girl will appear just as beautiful in the new movies, and her public will not run the risk of being disappointed on seeing her in person as they now are.

● Cost the Prime Factor

It is apparent that all the real difficulties hinge on costs. But as with every other scientific advance, these expenses will diminish as production goes up and as inventive minds set about solving the problem of reducing them.

In the early stages of the new movies the more spectacular effects will be emphasized. Moving objects which can be made to approach within a few inches of the observer will leap from the screen and audiences will scream and duck from them. Shots of autos or tanks apparently running over the cameraman can be made terrifyingly effective. The observer, forgetting that he is watching a picture, will be certain that he is in imminent danger of death.

By altering the distance between the lenses of the camera and by utilizing the proper relationships of focal

(*Foot of Col.* 1, *next page*)

Letters to the Editor

Editor, International Projectionist:

Misplaced changeover marks continue to constitute one of the worst abuses of exchange practice, and constant reference to same in your journal evidently serve only to bore the exchange fellows. In the feature "In Name Only" a fadeout occurs about 15 feet from the end of the reel, and as soon as the incoming scene opens there is the changeover dot! In old film where a piece is missing either at the end of one reel or the beginning of another, or if the film be run down a little, the missing dialogue makes a lot of difference. The effect of entire scenes is lost. I don't know the answer; do you?

Why doesn't I. P. run an article explaining the various steps in Technicolor production—that is, how such a print is produced. I have only the haziest idea how the color gets on the film, and I doubt very much that I am alone on this.

S. Robbin, Chicago, Illinois

[I. P. has long advocated careful pre-show inspection of every foot of film on a program, with a written report of the findings going to the manager. This practice won't replace missing marks or alter their position, but it will serve to protect Mr. Projectionist.

For the suggestion anent a Technicolor article, thanks. It's already in the making.—Ed.]

Editor, International Projectionist:

During your recent visit to . . . I failed to file a few questions during the open forum that was held. At present I am trying to obtain a suitable amplifier for our theatre. Our original equipment was an RCA P.G. 10 amplifier with V-type soundheads. We seat 630, having about 72,000 cubic feet of space. The "information" we get from these so-called sound system salesmen really is a laugh: One pamphlet sent around, and evidently relied upon to sell the job, gives this engaging dope: "Attractive gray wrinkle finish cabinet . . . conduit knockouts located for rapid installation . . .", *etc., etc.* This is great salesmanship: not a word about power output, type of changeover, or exciter supply.

Wide Difference of Opinion

Anent the RCA line we encounter the same thing, only they do show a field supply unit for the 138. Evidently the 105 has permanent magnet speakers. RCA rates the output of the 105 at 9½ watts. Our serviceman, however, rates the same amplifier at 3.5 watts at 2% distortion. RCA rates the 138 at 15 watts output. Our serviceman rates the same job at 5 watts. We need 10 watts and prefer a d.c. exciter, so it looks as though we shall have to get the RCA 139 job.

It seems incredible that it requires several days effort to get data that should be available immediately upon request. Why all the secrecy? Why not honest ratings? What about the various other amplifier types? Do they advertise? Where—in Popular Mechanics? I will appreciate any information.

New Englander

[It's almost incredible that field sales forces operate on any such basis. However, I. P. had no difficulty whatsoever in obtaining the appended data from RCA Mfg. Co., Inc.:

"The question of power output is, of course, very closely identified with the system of rating. In one field 2% distortion may be considered as an acceptable basis for rating whereas in another field 5% or 6% may be considered as entirely acceptable. This accounts to some extent for the comparatively wide divergence of ratings for amplifiers which appear to be quite identical in circuit, tubes, and quality of components.

"The RCA type PG-105 amplifier will deliver 4½ watts with not more than 2% distortion, and will deliver 15 watts with less than 6% distortion. This is rather unusual in that this amplifier has such a tremendous reserve of power with only a very nominal amount of distortion.

"Since the PG-138 amplifier system is quite similar to that used with the type PG-105, its output necessarily is approximately the same. The greatest advantage of the PG-138, of course, is that it provides in the low-priced class for the first time a genuine true cellular horn system. Other systems in the class on the market use a horn which is made to look like a cellular horn but which does not have the true characteristics of the genuine cellular horn.

"The only difference between the horn set-up of the PG-138 and the largest systems we make is that on the larger systems we add additional loudspeaker mechanisms in order to handle the tremendous power. For example, we take the identical cellular horn, replace the single unit throat with a two or four unit throat and use it for PG-139, PG-140, PG-141, PG-142, *etc.*, systems.

"The loudspeaker mechanisms themselves are identical, starting with the PG-138. All of these loudspeakers are of the energized field type for maximum efficiency. This applies even in the case of the PG-105 system, which uses our standard loudspeaker system.

"Both the PG-105 and the PG-138, as ordinarily sold, employ a.c. exciter lamps, and fading is accomplished by lighting one exciter lamp and extinguishing the other. D.C. exciter lamp operation can be secured by adding an exciter lamp supply unit which carries a moderate price. Both of these systems are very fine.

"Theatres today, however, are more inclined to provide much greater reserves of power than they were accustomed to in the past. This is because genuinely realistic reproduction of certain effects requires large power outputs. The PG-139 system actually delivers 30 watts with not more than 2% distortion. The PG-139 has other advantages in the way of control, *etc.*, which make it well worth the nominal additional amount of money required for its purchase.

"We neglected to clear up one point. Your correspondent drew the conclusion that the PG-105 has permanent magnet speakers because no field supply unit is included. This is because the field current in that case is obtained from the high voltage power supply of the amplifier. A separate field supply unit is included with the PG-138 because the heavy duty de luxe mechanisms require more field current than the amplifier power supply is capable of delivering."]

Port Huron, Mich. Mayor

JOHN F. CASSIN

Hizzoner! Starting as a theatre usher in 1916, Cassin, now 38, took up projection work in 1918. He has been successively president of I.A. Local 622, business agent from 1925 until the present, president of the P. H. Labor Council, founder of the P. H. Labor News, vice-president of the Michigan Federation of Labor, and finally, in 1937, State Commissioner of Labor and Industry.

Cassin intends to continue actively in the labor movement and will retain his posts as business agent of Local 622, Port Huron, and secretary-treasurer of the Michigan Alliance of Theatrical Stage Employees and Projectionists.

lengths, the depth of a picture can be greatly exaggerated. In this way, and without changing the speed of the camera, objects can be made to recede at apparently very high speeds. Such increased depth should lend added effectiveness to scenic views.

It also gives an opportunity for a curious alteration of a normal scene, for a gradual increase of the distance between the two lenses of the camera while pictures are being taken makes objects shrink in size and increase in depth. A building taken from above can thus be made to grow from a two-story structure into one of incredible height.

CINETYMER* REEL FOOTAGE TIMETABLE

(See Explanatory Article on Opposite Page)

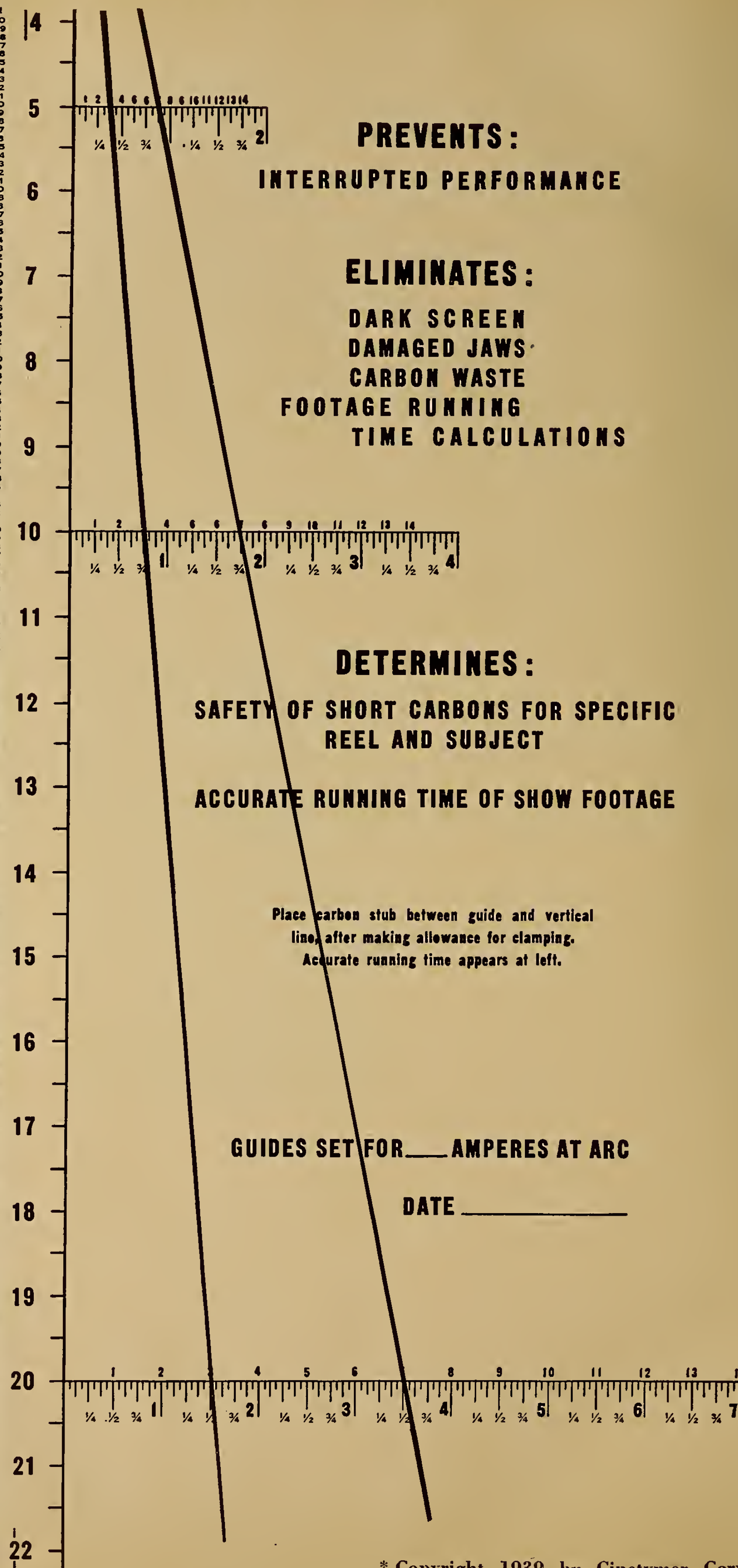
CLAMPING ALLOWANCE
¼ TO ½ INCHES

During first show or after measuring reel footage attach written notes in space below next to reel running time:

NAME OF SUBJECT
REEL NUMBER
CHANGEOVER CUES
VOLUME-TONE SETTINGS

CARBON CLAMPING
ALLOWANCE

Minutes	Feet
4.	380
4.1	389
4.2	378
4.3	387
4.4	398
4.5	405
4.8	414
4.7	423
4.8	432
4.9	441
▶ 5.	450
3.1	459
5.2	468
5.3	477
5.4	488
5.5	495
5.6	504
5.7	813
5.8	522
5.9	531
▶ 6.	340
6.1	548
8.2	858
6.3	567
8.4	578
6.5	885
8.6	594
6.7	603
6.8	612
6.9	621
▶ 7.	630
7.1	839
7.2	648
7.3	657
7.4	686
7.5	875
7.6	684
7.7	693
7.8	702
7.9	711
▶ 8.	720
8.1	729
8.2	738
8.3	747
8.4	756
8.5	765
8.6	774
8.7	783
8.8	792
8.9	801
▶ 9.	810
9.1	819
9.2	828
9.3	837
9.4	848
9.5	855
9.6	864
9.7	873
9.8	882
9.8	891
▶ 10.	900
10.1	909
10.2	918
10.3	927
10.4	836
10.5	945
10.8	954
10.7	883
10.8	972
10.9	981
▶ 11.	890
11.1	899
11.2	1008
11.3	1017
11.4	1028
11.5	1035
11.8	1044
11.7	1053
11.8	1082
11.9	1071
▶ 12.	1080
12.1	1089
12.2	1098
12.3	1107
12.4	1118
12.5	1125
12.6	1134
12.7	1143
12.8	1152
12.8	1161
▶ 13.	1170
13.1	1179
13.2	1188
13.3	1197
13.4	1206
13.3	1215
13.8	1224
13.7	1233
13.8	1242
13.9	1251
▶ 14.	1260
14.1	1289
14.2	1278
14.3	1287
14.4	1298
14.5	1305
14.6	1314
14.7	1323
14.8	1332
14.9	1341
▶ 15.	1330
15.1	1359
15.2	1368
15.3	1377
15.4	1386
15.5	1395
15.6	1404
13.7	1413
15.8	1422
13.9	1431
▶ 18.	1440
16.1	1449
16.2	1458
16.3	1467
16.4	1476
16.8	1485
16.6	1494
16.7	1503
16.8	1512
16.9	1521
▶ 17.	1330
17.1	1339
17.2	1348
17.3	1557
17.4	1568
17.5	1375
17.8	1584
17.7	1593
17.8	1802
17.9	1811
▶ 18.	1620
18.1	1829
18.2	1638
18.3	1847
18.4	1638
18.5	1665
18.8	1674
18.7	1683
18.8	1892
18.8	1701
▶ 19.	1710
19.1	1719
18.2	1728
19.3	1737
19.4	1748
19.5	1753
19.6	1784
19.7	1773
19.8	1782
19.9	1791
▶ 20.	1800
20.1	1808
20.2	1818
20.3	1827
20.4	1838
20.5	1845
20.6	1854
20.7	1863
20.8	1872
20.9	1881
▶ 21.	1890
21.1	1899
21.2	1808
21.3	1917
21.4	1928
21.5	1935
21.6	1944
21.7	1953
21.8	1962
21.9	1971
22.	1980
22.1	1989
22.2	1998



PREVENTS:

INTERRUPTED PERFORMANCE

ELIMINATES:

DARK SCREEN
DAMAGED JAWS
CARBON WASTE
FOOTAGE RUNNING
TIME CALCULATIONS

DETERMINES:

SAFETY OF SHORT CARBONS FOR SPECIFIC REEL AND SUBJECT

ACCURATE RUNNING TIME OF SHOW FOOTAGE

Place carbon stub between guide and vertical line, after making allowance for clamping. Accurate running time appears at left.

GUIDES SET FOR____AMPERES AT ARC

DATE ____________

Novel Cinetymer Reel Footage Indicator

NOVEL and very practical is a highly accurate reel footage indicator conceived and executed by Henry Behr, supervisor of projection for the Wilmer & Vincent circuit of theatres along the Eastern seaboard. Known as the Cinetymer Reel Footage Timetable (and copyright by the Cinetymer Co.) this indicator has proven its worth in innumerable tests in all types of theatre projection rooms and under every conceivable method of programming.

On the opposite page appears an overall view of this Cinetymer Timetable, the two oblique black lines thereon representing movable strips (of either wood or cardboard) which are fastened through a hole at the top of the chart in such fashion that they swing freely across its face. The chart itself is fastened to some rigid base, either cardboard or light wood. Table A provides an example of how the accurate running time of the reel of film appears next to the footage and thus assists materially the projectionist in setting up the show schedule.

It is apparent from Table A that in this example the complete program runs 2 hours, 46 minutes, 18 seconds.

TABLE A

EXAMPLE:	Reel Number	Reel Footage	Running Time	
Feature	1	1692	18.8	89.5 minutes
"	2	1935	21.5	
"	3	1764	19.6	
"	4	1998	22.2	
"	5	666	7.4	
Comedy	6	1593	17.7	38.1 minutes
"	7	1836	20.4	
Musical	8	2052	22.8	
News & Trailer	9	1044	11.6	
Non-Sync Music or film		387	4.3	
		14,967	166.3	

Each .1 minute equals 6 seconds of running time. This procedure eliminates use of fractions of a minute. The space on the extreme left is for the purpose of attaching notes next to each reel running time for name of subject, reel number, changeover cues, and volume changes.

To obtain the running time instantly without calculations when the footage is known: look in column for the show footage, nearest to printed footage multiplied by 10. Next to this is equivalent running time in minutes arrived at by multiplying by 10. Example:

Total, all subjects		14,967 ft.
Nearest prtd. ftge. x 10		14,940 ft.
Printed time 16.6 x 10		166 min.

Anent the carbon burning gauge, the rules are for 5, 10, or 20 minutes burning time of any carbon. Select the number over the rule nearest to the known burning time. Draw a line or place the strip up and down through the corresponding guide numbers on other rules. This instantly establishes the burning rate for the particular carbon piece from 4 to 22.2 minutes (360 to 1998 feet of film). Additional settings may be made when there is occasion to vary the arc burning rate. Make allowance for clamping to the left of vertical line.

Operation: Place negative or positive carbon in horizontal position to the left of proper guide line or strip, after making allowance for portion of carbon required for clamping. Move the carbon up and down until it fits exactly from left to right. The burning rate in minutes and seconds appears directly opposite. Corresponding reel footage is right next to the time on which the particular carbon piece may be safely used. The projectionist may ascertain quickly and accurately whether or not any carbon piece will operate to the end of the reel and thus avoid a blank screen or damage to the carbon jaws. Gauge can be set to measure the burning time of carbons used in spotlight, floodlight, effect machine or steropticon.

When the burning rate is not known, the gauge setting can be made from guide line number designated for each size carbon. (Guide line numbers represent one-eighth inch burning rate on the 5-minute rule.) When actual burning rate shows a great difference, it is an indication that meter may be out of adjustment, or of poor electrical connections, or of wrong arc gap. Intermediate burning rates will be proportional to those shown in Table B.

TABLE B

TABLE OF BURNING RATES FOR SOME TRIMS IN GENERAL USE

Type Carbons	Amperes of Arc	Positive Size	Positive Guide Line Number	Negative Size	Negative Guide Line Number
Super High Intensity	140	13.6 mm.	8½	1/2" H.D.	2
" " "	160	13.6 "	12	1/2" "	2½
Regular High Intensity	110	13.6 "	6	3/8"	2
" " "	110	13.6 "	6	7/16"	2
" " "	120	13.6 "	8	7/16"	2
" " "	125	13.6 "	8½	7/16"	2
" " "	130	13.6 "	11	7/16"	2
" " "	75	11. "	6	11/32"	2
" " "	85	11. "	7½	11/32"	2
" " "	90	11. "	8	11/32"	2
" " "	95	11. "	10	11/32"	2
" " "	75	11. "	6	3/8"	1½
" " "	90	11. "	8½	3/8"	1½
Orotip	60	9. "	5½	5/16"	2
"	70	9. "	7	5/16"	2½
"	85	9. "	11½	5/16"	2½
Cored Low Intensity	21	12. "	1½	8 mm. (Solid)	1½
" " "	25	12. "	1½	8 " "	1½
" " "	16	10. "	1½	7 " (Cored)	1½
" " "	20	10. "	2	7 " "	1½
S.R.A. Cored	28	12. "	2	8 " "	2
" "	32	12. "	2	8 " "	2
A.C. Copper Coated	75	8. "	3	None (AC)	–
" " "	80	8. "	3½	" "	–
Suprex	35	6. "	5	5 mm.	2½
"	40	6. "	7	5 "	3
"	40	7. "	4½	6 "	2½
"	45	7. "	7	6 "	2½
"	50	7. "	9	6 "	2½
"	50	8. "	4	7-6.5 mm.	2½
"	55	8. "	6	7-6.5 "	2½
"	60	8. "	7	7-6.5 "	3
"	65	8. "	9	7-6.5 "	3

Non-Theatrical Projection: The Balopticon

Many and diverse are the activities engaged in by not a few projectionists apart from their regular daily craft work, ranging all the way from the practice of law to chicken farming. Hewing closer to the craft line are those who busy themselves in some allied branch of cinematography, such as the taking and showing of local newsreels, the handling of projection for clubs and fraternal groups, etc. The appended article anent the Bausch & Lomb Balopticon was suggested by a projectionist who for many years has been eminently successful in such outside activity, and who thinks that such data would be both informative and inspirational to other craftsmen.

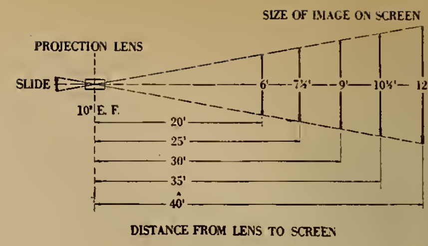


FIGURE 2

BALOPTICONS are still projectors, and still projection is the form most suitable for instructional use. The attention of everyone in the audience can be directed to the same thing at the same moment. Ample opportunity is provided for close observations and discussion. The subject matter on the screen can be made pertinent. The method is flexible: any picture can be shown as long as desired, can be repeated whenever needed, and can be used with a greater variety of audience types and ages than other methods.

Furthermore, there is no difficulty and little expense in obtaining illustrations. Magazines, books, maps, sheet music, classroom papers, manuscripts, drawings, slides, strip film, small solid objects, microscope specimen slides—all can be projected by Balopticons.

Glass slides doubtless approach nearest to perfection in visual aids to education. Slides are easy to make, are inexpensive to rent, can be easily colored, give a clearer and larger image at a greater distance than any other medium, and will not buckle or curl under extremes of heat.

Opaque Object Projection

Opaque projectors are excellent aids in presenting an extremely wide range of subjects. The material that can be projected is almost unlimited and the cost insignificant. Almost any kind of opaque object—from book pages intact to geology fossils, and from the mechanism of a watch to an outline map—can be shown by this method, either in darkened rooms or under "daylight" conditions.

The screen receives only such light as can be reflected by the photograph, book-page or other opaque object. Consequently, the projected image is not as bright as in the case of transparent glass slides. For this reason the room in which opaque objects are projected should be as dark as possible. Combined Balopticons, for projecting slides as well as opaque objects—with instant interchange between the two methods of projection —are recommended for exacting work.

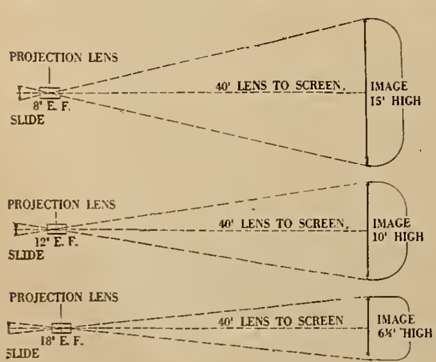


FIGURE 1

Still films are today supplementing—but are not supplanting—regular glass slides. The printing of individual pictures on standard-width motion picture film offers an inexpensive and convenient method of using pictures for educational and entertainment purposes. Such film, known as "strip film," and "film slides," can be purchased from a number of educational and commercial organizations at a price approximating the rental cost of glass slides.

Either a special film projector or an attachment for use with standard Balopticons is needed for this form of projection. Inasmuch as strip film has certain limitations, especially in regard to fine details and color, the purchase of a combination instrument which will permit the projection of both glass and film slides is recommended.

It must be remembered when purchasing a film projector that the same amount of detail and color that is possible with a 3¼ x 4-inch glass slide is not possible with the small ¾ x 1-inch area of the strip film.

"Daylight" Projection Procedure

There is nothing magical about "daylight" projection. Any of the regular Balopticons with short focus lenses, located close enough to the screen to produce a small picture, with concentrated illumination, may be used with entire satisfaction in rooms that are moderately well lighted. A special transulcent screen placed between the projector and the audience adds to the brilliancy of the picture, and so aids in counteracting the effect of the light in the room.

This form of projecting either slides, opaque objects or strip film eliminates the inconvenience of totally darkening the room, and allows sufficient light for taking notes. On the other hand, the size of the picture is greatly reduced and the value of the method is correspondingly decreased, its use of necessity being limited to comparatively small groups.

Illuminants—All models of Balopticons are regularly supplied with Mazda this type of illumination being superior to other forms for the following reasons: (1) entirely silent and automatic; (2) illumination is of excellent quality, ample and steady; (3) no rheostat is required; and (4) economical and simple to operate.

The capacity of these lamps, as used on B. & L. instruments, ranges from 200 watts on the small film projector to 1000 watts on the large CLM Balopticon, the 500 watt bulb being most commonly employed. All of these bulbs, except the 1000 watt size, can be operated from any standard lighting outlet. The 1000-watt bulb requires an outlet of 10-ampere capacity.

Bulbs of slightly higher or lower voltages can also be supplied to meet local requirements; also 6-volt, 24-watt bulbs for use with storage batteries, or arc lamps which must be used with a rheostat, or acetylene burners when electricity is not available in any form.

Focal Lengths—In purchasing an apparatus for the projection of either slides, strip film or opaque objects, a point which should receive careful attention is the selection of an outfit with the correct focal length of lens to meet the specific requirements. The equivalent focal length (E.F.) of a lens or combination of lenses is the measure of the distance from the lens to the point at which all rays coming from a distant object would form a sharp image.

The focal length is accordingly directly proportional to the distance from lens to screen—and inversely proportional to the size of the image on the screen—other factors being constant. This emphasizes the fact that the projection distance and the size of the image on the screen must be determined definitely before ordering a Balopticon.

Size of Screen Image

Figure 1 illustrates how the size of the image on the screen is inversely proportional to the focal length of the projection lens—provided the distance between lens and screen remains constant.

Figure 2 shows how the size of the image on the screen varies directly with the distance from the lens—the greater the distance from lens to screen, the larger will be the image on the screen.

A point to bear in mind is that the intensity of illumination per unit of area varies inversely as the square of the size of the picture, therefore, the smaller the picture the more brilliant it will be. On the other hand, the picture should be large enough, of course, to enable those seated at the farthest points from the screen to see all of its details without difficulty.

A fairly safe rule to follow, according to Prof. A. H. Gage of Cornell University, is to determine upon a picture equal in width to about ¼ or 1/5 the distance from the screen to the farthest point at which it will be observed.

Having thus established the two determining factors mentioned, one has only to refer to the tables which cover the kind of projection and the size of projected area offered by his apparatus (these data accompany every Balopticon). These tables give in feet the length of one side of the screen image to be obtained at the different projection distances and with the different lens foci indicated.

Mixed Industry Prospects Seen By Poor's Survey

The motion picture industry has mixed prospects, as a result of the European War, according to Poor's Industrial and Market Surveys. Should the markets of

all the warring nations remain closed to its films, the industry would stand to lose roughly 60% of its foreign revenue and 25% of its total gross. A 20% rise in production costs promises to cut deeply into profits, moreover, although economies presumably will be effected. Although total revenues will be supported by a fairly good level of receipts derived in domestic and South American markets, a decline in total income is indicated.

Export Market Crippled

Reflecting the outbreak of European hostilities, a decided downtrend in exports of domestic films will be experienced during coming months. However, because Argentina, Brazil, and Mexico are among the five leading foreign markets for this country's films (taking 22% of the number of positive feature prints exported during the 1939 first six months, or twice as many as the United Kingdom and France combined), the decline will not be so sharp as would appear at first glance. Moroever, lack of competition from belligerents will enable U. S. producers to enter South American markets heretofore closed. Unsatisfactory foreign exchange, quota systems, and other restrictive measures designed to foster industry in these countries, however, may prove to be offsetting factors.

Domestic Prospects Mixed

In the domestic market, the outlook is somewhat brighter. On three premises: (1) a prolonged war abroad (2) maintenance of U. S. neutrality, and (3) repeal of the arms embargo, a marked rise in domestic industrial activity is forecast. Higher consumer incomes, which should accompany this development, would be reflected in greater theatre attendance. This, in conjunction with admission price increases (as proposed), is favorable to higher box-office receipts from domestic theatres. A sharp rise in living costs, however, might cancel much of the improvement indicated.

Meanwhile, a combination of political factors is disturbing. In addition to the Government's antitrust suit are: (1) the Neely "block-booking" bill, passed by the Senate but still to be approved by the House, and (2) threats of N.L.R.B. hearings on wages, strikes, and union activities. At this juncture, it is difficult to forecast the ultimate outcome of current and pending litigation. As for "block-booking," arguments pro and con seem to be pretty well in balance. Whether its elimination ultimately would prove beneficial to the industry is anybody's guess. Increased competition and higher production costs would be a natural consequence.

RCA LONG-LIFE NEEDLE

RCA offers a new long-life phonograph needle capable of 1,000 playings without distortion under normal conditions, and which provides accurate reproduction of tone combined with a minimum of record wear. Four main points of superiority are cited: long life, its kindness to record surfaces, faithful reproduction, and com-

parative low cost. Tests indicated good reproduction for more than 1,000 playings, however, any needle's life is dependent on such varying and uncontrollable factors as weight and type of pickup, age and condition of records, *etc.*

NEW LIGHT-SPEEDOMETER

WHAT is believed to be the most accurate speedometer in the world, which automatically measures the speed of light, fastest thing in the universe, traveling at the rate of 186,000 miles a second, was announced at Harvard University, and reported in *The New York Times*, from which the following information was taken.

This new light-speedometer was described as the first that does not require visual observation by the human eye and that eliminates friction as a possible source of error. It can measure the velocity of light, it was stated, with an error of less than 2½ miles a second, and therefore is believed to be capable of giving the most accurate measurements of the speed of light ever made. The device does its work by "crimping" the light beam to be measured with what may be described as "permanent waves" 19,200,000 of such waves a second.

The equipment has been put to work on one of the basic problems of modern physics and astronomy, namely, whether the speed of light is actually constant under all conditions or whether it varies.

Self-Measuring of Light

Although many important theories, including the theory of relativity, are based on the assumption that the velocity of light is constant, recent new measures have indicated that it may vary under certain conditions. Should this be established, it may call for important modifications of the relativity theory and its consequences.

In contrast with the large size of some types of light-speedometers, which utilize long outdoor tubes, the apparatus is contained in a small laboratory room and hallway. With the equipment four separate measures of the speed of light can be made a minute.

The basic principle of the device is to impose a wave-form on a light beam in such a way as to compel the light to help in the measurement of its own speed. The beam originates in a high-power 1,000-watt projection lamp. It passes first through a tube which modulates the beam at a frequency of 19.2 megacycles. In other words, the beam is made to fluctuate between bright and dim intensity 19,200,000 times a second.

Modulation of the light beam at the high frequency is controlled by a standard frequency generator. With the frequency of the manufactured light waves known, the main problem is to determine the exact length of the waves.

The fluctuating beam is split in two by a small sheet of glass held at an angle across the light path. One side of the beam is sent off, up and down a hallway system of mirrors, until it has traveled a distance of about 185 yards. The distance is fixed and has been measured with an accuracy of one part in 200,000.

The other half of the beam is sent over a shorter path, about two yards long, whose length is slowly varied during the velocity measurement. Each half of the beam has the same wave-form, or light to dark fluctuations, as the original.

DEFECTIVE HEARING FILM

"Life Begins Again," movie produced and distributed by W.E. illustrates how many of the more than 15,000,000 Americans suffering from hearing deficiencies can be enabled to hear again. The picture dwells

particularly on problems arising in the case of school children who have impaired hearing and demonstrates the correct procedure for discovering hearing deficiencies by means of audiometric test. Included in this film is an interesting animated sequence which demonstrates clearly how the human auditory system functions. The film is available to theatres without charge.

A Layman's View of Television Programs' Worth

NOTE: The appended statement was contained in a letter by one W. E. MUSSETT to the editor of the N. Y. Times.

The article in The New York Times Magazine of Oct. 1 "Television From Backstage" proved interesting and informative. In fact, The Times has kept its readers excellently informed on the progress of television ever since the beginning of this industry.

The "vicious circle" type of reasoning cited by Mr. Schwarz—evidently it is widespread—should be punctured. The first premise is, "We can't sell sets because we haven't enough good programs." Instead it should read, "We can't sell sets because they're too costly." And by too costly I mean that television receivers are liable to rapid mechanical improvement, thus making their purchase something of a speculation. Also, in proportion to the cost, the quality of programs is hardly high enough and their quantity is too small.

Comparative Merits of Media

"We can't get enough good programs because there aren't any advertisers to pay for them." In answer to this second premise Mr. Schwarz quotes a television program director. Although this man's answer is true, it isn't enough. There's still the question of whether advertisers will bother to use television for many years. It will prove difficult to prepare and present a television advertising message.

Besides this, there is the question of how effective this medium will be in comparison with other media. If, for example, the complete cost of a 15-minute television program were equal to that of a 15-minute radio broadcast, could the advertiser be certain that the impression made on his audience by his television commercial would be as deep as that of his radio commercial? Here is a question for psychological research.

WARNER 'SOUND TRANSMITTER'

Warner Bros. studio technicians have invented an "invisible sound transmitter" which enables a player to hear music, cues and instructions which must not figure in the completed picture.

Sound of any sort is sent into an off-scene microphone and is conveyed to the actor through a tiny bone conductor attached to his spine under his clothing. In turn, the bone transmits the sound to him. It permits transmission of inspirational music to the player in a highly emotional sequence as in pre-sound era.

N. T. S.'s NEW P. A. LINE

National Theatre Supply Co. has a new exclusive line of public address systems developed by Radio Development and Research Corp. It will be the first such line to be sold with an unqualified 1-year guarantee and installation supervision by Altec. The line ranges from a portable system rated at 8 watts to sell for $79.50 to a de luxe theatre type with an undistorted output of 35 watts listing at $875.

Any part of the basic systems may be re-adapted and combined to take care of any special installations. A manual giving technical and other data is now in preparation.

FILM FREIGHT SHIPMENTS

Recent ruling of the I.C.C. permitting motion picture film to be sent by freight will save many thousands of dollars yearly in shipping prints to exchanges. New ruling went into effect Dec. 6.

It is estimated that from $150 to $207 can be saved in sending prints from the laboratories to the distributors' branches in key cities, although time in transit will be 10 days from Coast to Coast compared with four days by railway express. Advantage can be realized only when there is no great rush in getting prints to exchanges. Railway express can transport films almost as quickly as the fastest passenger trains.

EXCHANGE WORKERS PACT

Increases granted recently to the exchange employes union members throughout the country provide for a head inspectress where three or more inspectresses are employed, with a minimum of $18.50 per week for all inspectresses. Where two or more shippers are em-

ployed there must be a head shipper, with assistant shippers minimum placed at $21 per week. Other principal change in terms of the pact increased the pay of night workers.

MONEY-MAKING STARS

Exhibitors of the U. S. by a wide margin declared young Mickey Rooney the outstanding money making star of 1939, in the annual *Fame-Motion Picture Herald* poll of money-making stars.

The full list of the leading 10 money making stars follows, in the order of their exhibitor evaluation, based on patron cash across the counter, and the percentage each attained:

1.	Mickey Rooney	870
2.	Tyrone Power	677
3.	Spencer Tracy	556
4.	Clark Gable	442
5.	Shirley Temple	339
6.	Bette Davis	315
7.	Alice Faye	271
8.	Errol Flynn	253
9.	James Cagney	226
10.	Sonja Henie	219

A total of 12,273 exhibitors were polled, 8,096 of whom were independents and 4,204 operators of circuits.

They answered this request: "Please list in the order of their box-office strength the 10 players whose pictures drew the greatest number of patrons to your theatre from Sept. 1, 1938, to Sept. 1, 1939, without regard to age of picture, net profit, length of run, nature of competition or other conditions (weather, etc.) during exhibition."

C. G. STOLL HEADS W. E.

Clarence G. Stoll has been elected president of the Western Electric succeeding Edgar S. Bloom, who retired on Dec. 31. Mr. Stoll has been vice-president in charge of operations since 1928. He has spent his entire business career of 36 years with W. E., having risen from student apprentice to become now its chief executive.

NEW ALTEC DIRECTOR

T. H. Blodgett, president of American Chicle Co. to the board of directors of Altec Service Corp. Blodgett succeeds B. L. Allen, deceased.

FILM BOOKLET AVAILABLE

A pamphlet containing the regulations of the National Board of Fire Underwriters for nitrocellulose motion picture film, as recommended by the National Fire Prevention Assoc., is now available to projectionists. Direct request to the Underwriters at 85 John St., N. Y. City, mentioning I. P.

S.O.S. CORP. EXPANDS

S.O.S. Cinema Supply Corp., of N. Y. City, has taken over International Theatre Accessories Corp., with which S.O.S. was affiliated for years at 636—11th Ave. S.O.S. recently absorbed Consolidated Theatre Supply Corp., formerly at 1600 Broadway, N. Y. City, and is now negotiating the acquisition of another equipment manufacturer said to be in business since 1922.

NETWORK TELE POSSIBLE

Network television is possible, according to Edwin Armstrong, inventor of the frequency modulation radio transmission. Television, he said, which operates on the same wave-band as frequency modulation,

could be transmitted and re-telecast by stations without the use of leased wires in a manner similar to that employed in the radio broadcast tests.

"When and if there is a television chain," Armstrong stated, "it will be done with frequency modulation. The technical principles are the same in television as in frequency modulation."

THIS GLAMOUR BUSINESS

Latest check-up reveals that 13 Chicago theatres are using triple bills, a sharp reduction from previous count. One house is experimenting with 4 features. Premiums are used in 21 theatres.

CONSTRUCTION PROSPECTS POOR

Because prospects indicate only moderate increases in domestic theatre attendance, there is small incentive for building new film outlets or enlarging present ones. Some improvement may be witnessed later this year, however, if the industry's prediction of an upswing in domestic box-office receipts this Fall and Winter actually is realized.

'INSPIRED' LEADERSHIP

James C. Petrillo, president of the Chicago A. F. of M., says that the name of John L. Lewis, head of the C. I. O., the A. F. of L.'s rival, must not and shall not be mentioned on the stage in that city. The theatres can have music without Lewis, or Lewis without music. They cannot have both. Three producers have already capitulated to his demands.

Petrillo believes that if you don't mention something, it doesn't exist; and that if you can stop people saying what they think, they'll stop thinking it. The two countries where this system is having a perfect workout are Germany and Russia. —*N. Y. Times.*

NOVEL LOUDNESS TESTS

It has long been the ambition of scientific workers to connect the cable of nerve fibres in the human hearing mechanism to electrical apparatus and investigate what happens when the ear is stimulated with a sound. With precise information about the messages sent to the brain by the basilar membrane keyboard, it is possible that the problem of what it is that determines the loudness of a sound could be solved.

Of course, the surgical operation necessary to bare the auditory nerve and tap the cable is much too serious to be undertaken for experimental purposes, but it has been done elsewhere with animals under anesthesia, and very interesting results obtained. Fortunately, there are other methods of investigating the subject of the loudness of sounds, and these are now being employed in work done at Bell Laboratories.

PARASITIC PEC VIBRATION

As a protection against noise originating in projector vibration, sound head amplifiers are often mounted in spring-suspension cradles. The photocell, however, is mounted rigidly. It is part of the light system in which every component is mounted rigidly to the sound head frame. As long as they all vibrate in unison no harm is done. Parasitic physical vibration of any single component, however, destroys the unity of the system, and is heard as noise.

'CAN'T HAPPEN TO ME—'

(*Continued from page* 11)

when sleeves are rolled up, and even through nails in shoes.

Take care not to work in an awkward position. Men often squat down before a low panel or cabinet, feel themselves falling backward, and reach for a handhold. Be well set before working, or preferably find a suitably low object upon which to sit. If it be a metal object, put a newspaper on it. If the floor of the projection room is not itself a good insulator, or if it is partly covered by a metal projection such as sometimes forms the base of an amplifier mounting rack, put a newspaper down before working on live wires.

All these precautions, and any others that may come to mind as needed or appropriate in a given situation, should be thought of well in advance of emergency, should be "present" to the mind of the projectionist just as much as the location of his spare fuses or the method of connecting his circuit tester.

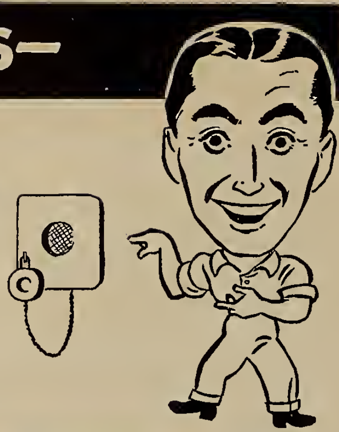
● First-Aid Hints

If, despite all precautions, one member of the crew is caught by a live circuit and can't let go, DON'T rush to help him. The voltage may be strong enough to hold two men, or to throw two men. If possible, open the circuit instead of trying to pull the victim away from it. If it be necessary to take hold of the victim, do it through a rag, a handkerchief, or his own clothing; use a dry stick. or rope or even a wad of newspaper.

If the victim be rendered unconscious, he will need artificial respiration immediately, and he may need a doctor. Stop the show and ask if there is a doctor in the audience. The management may not welcome that idea, but five minutes may mean the difference between life and death. The current acts by paralyzing respiratory and heart action. If the heart is beating, artificial respiration will bring the victim around, although in some cases it has had to be prolonged for as much as eight hours. If the heart is stopped, however, only an injection of adrenalin or other medical procedure beyond the ability of the projectionist will restore its action, and these measures must be taken within a very few minutes.

Artificial respiration is of the same type applied to victims of drowning. The patient is laid prone, back up, face turned to one side and resting on hand or forearm for easy breathing. The other arm is extended upward. Kneel, straddling the body, with the palms of the hands on the victim's back, the fingers touching the lower ribs and curved around them. Do not move the hands. Bend forward slowly, increasing the pressure on the lower ribs; do not bend your elbows but keep your arms stiff. Maximum pressure should be reached in about two seconds; swing backward immediately to release the pressure. Repeat after a two-second delay.

Artificial respiration should be applied at the earliest possible moment, without taking time out even to move



the victim to a more comfortable location, and should be continued *without interruption* until either the patient has recovered or a doctor pronounces him dead.

After artificial respiration has begun, and while it is continuing, any tight clothing about the patient's neck, chest or waist should be loosened.

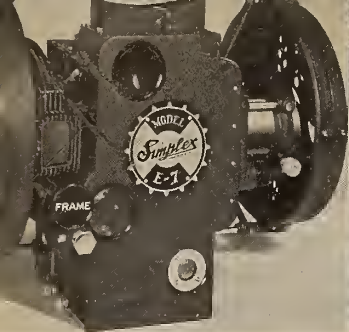
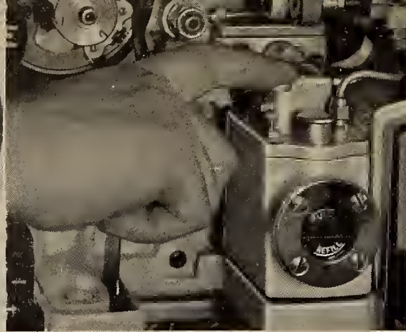
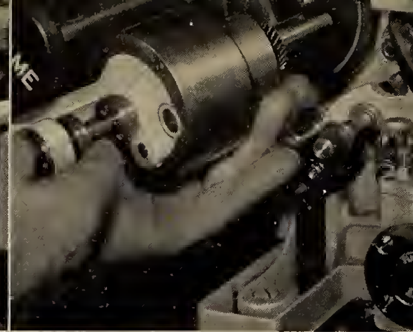
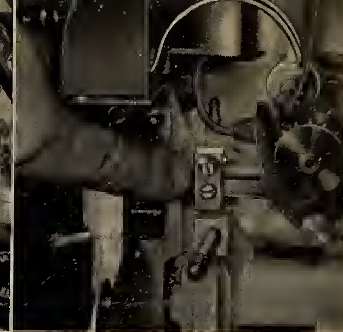
The patient must be kept warm. Note Crowley's account of the irresistible chills he experienced. The body of an unconscious person becomes cold in a very short time, and one of the major dangers of electric shock is the pneumonia that often follows apparent recovery. Since the body no longer generates normal heat, blankets and other common measures for keeping heat in are inadequate. There isn't enough natural heat to be kept in. Heat must be applied in the form of heating pads, hot bricks, by electric radiators or proximity to a steam radiator, *etc.* Pads or hot bricks, of course, call for blankets to conserve their heat and allow it to spread to different parts of the body. Radiators (and hot bricks, too) must be used with extreme caution because the patient is unconscious and cannot protect himself against being burned.

● M.D. the Best Bet

Because of the strain on the heart the patient must be kept quiet and lying down even after consciousness is recovered. He must be kept warm. If natural breathing stops, artificial respiration must be resumed. When consciousness has been finally established the patient may be given a drink of hot coffee or tea, but no drink of any kind should be administered to the victim while he is in an unconscious or semi-conscious state: it may choke him.

These first-aid precautions do not in any sense replace the skilled attentions of a medical man; at best they only help temporarily until the doctor arrives, and he should be obtained as quickly as possible. The condition of a victim of electric shock is often complicated by the mechanical injuries that may have been sustained when he was "thrown"—skull fracture for one.

Where there are two men in a projection room, the same man cannot apply artificial respiration and telephone for doctors at the same time. The artificial respiration must not be delayed or interrupted. Stop the show or do something else that will bring the manager or an usher to the projection room; start respiration immediately and do not interrupt it on any account, but let the manager or usher get the doctor, preferably from the audience.

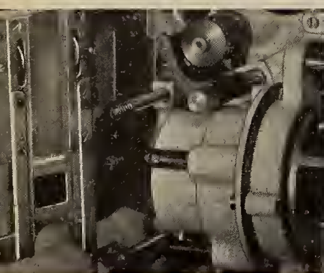





ranized Front and Rear Shutters — Each r acts upon one half the beam. A dis-ng effect is created and A MUCH PER PICTURE SECURED.

One-Shot Oiling System — Insures adequate supply of clean filtered oil, CLEANER PICTURE, LONGER LIFE, LESS MAINTENANCE.

Intermittent Movement — Readily removable. Oil System PREVENTS BLURRED PICTURES, NOISY SOUND, and Oil Cushion GIVES LONGER WEAR, REDUCES VIBRATION, AND INCREASES STEADINESS.

Film Gate Guide Studs — GATE WA ELIMINATED.



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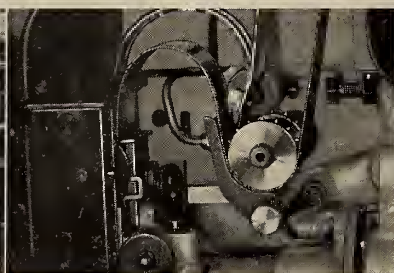
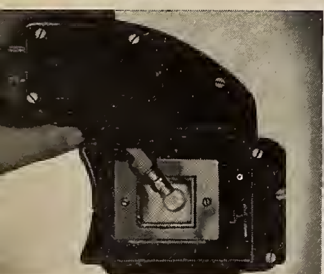


Automatic Fire Shutter Safety Trip — ABSOLUTE FIRE SAFETY.

Studio Type Guides—Side motion of film is controlled by replaceable guides which act in conjunction with guide rollers. PREVENTS SIDE SWAY OF FILM.



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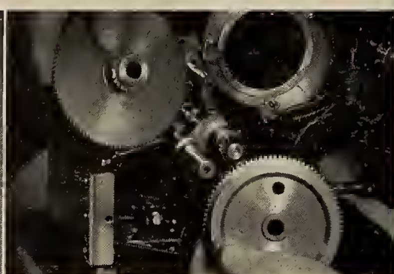
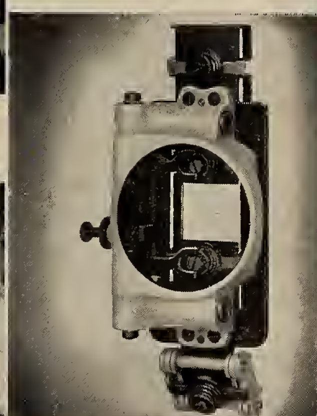
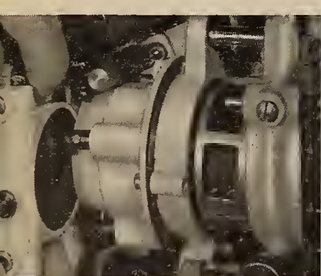


Oversize Drive Gears — LONGER LIFE, EASIER MAINTENANCE.



Improved Film Gate — Cone-shaped pad springs keep BOTH EDGES OF FILM UNDER EQUAL TENSION.



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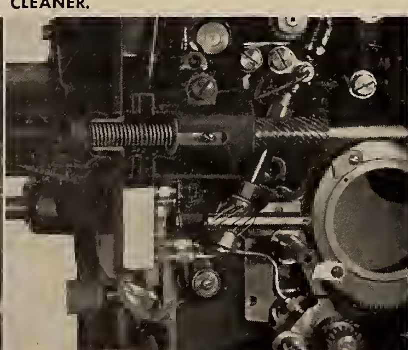
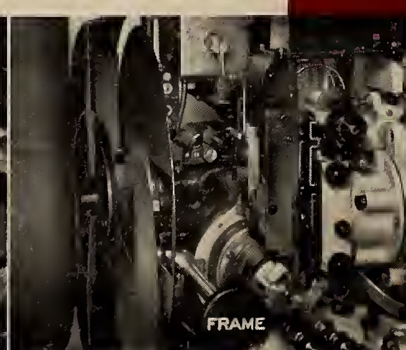
Air Deflector and Aperture Cooling Unit — IMPROVES LIGHT, REDUCES HEAT AT THE APERTURE. KEEPS MECHANISM CLEANER.

Simplex E-7 GIVES YOU A LOT FOR YOUR MONEY

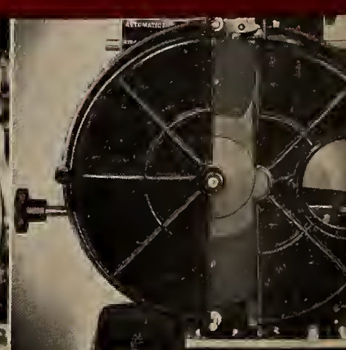
Type Governor for Fire Shutter—BIND-F, SILENT.



Shutter Synchronizing Device—PREVENTS BACKLASH AND TRAVEL GHOST CAUSED BY WEAR IN SHUTTER ASSEMBLY.



Rear Shutter Cooling Fins — INSURE MUCH COOLER FILM PATH.



Rear Shutter Guard—Can be quickly rem without disturbing lamphouse. SIMP FIES CLEANING.

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